The American Journal of Surgery

EDITED BY THURSTON SCOTT WELTON, M.D.

April 1945

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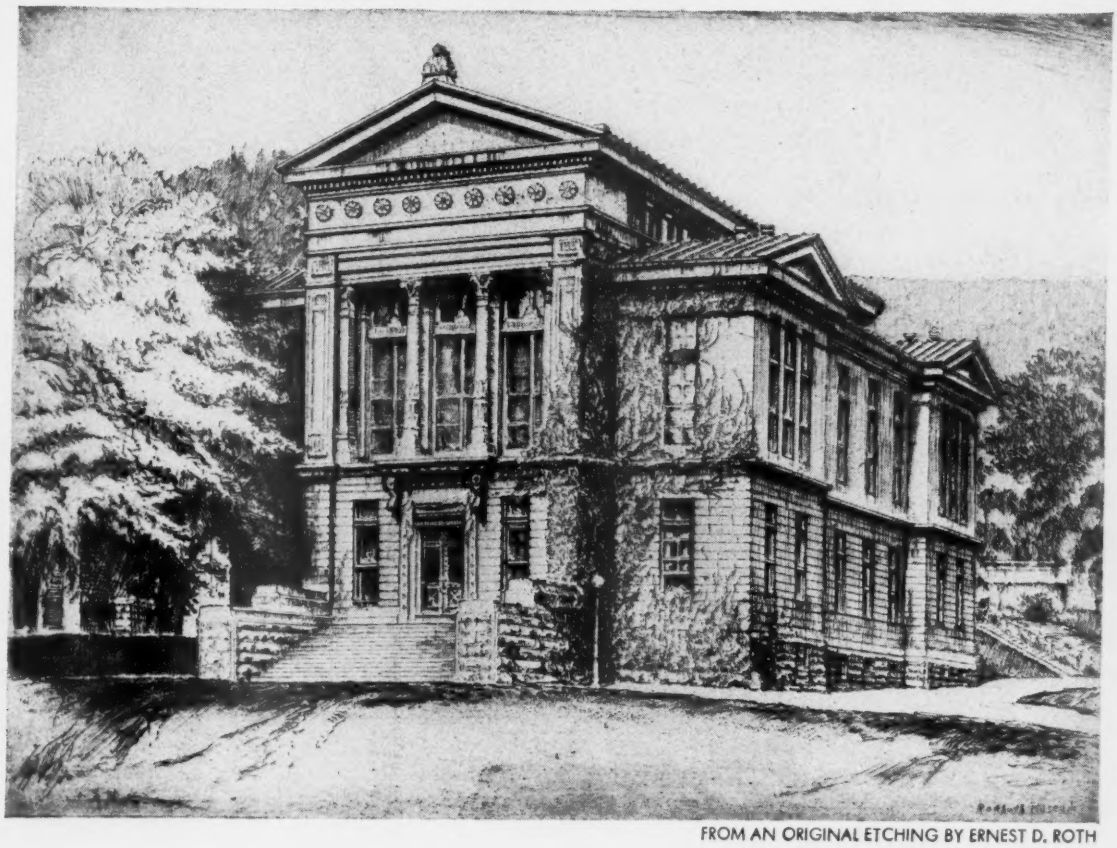

FROM AN ORIGINAL ETCHING BY ERNEST D. ROTH

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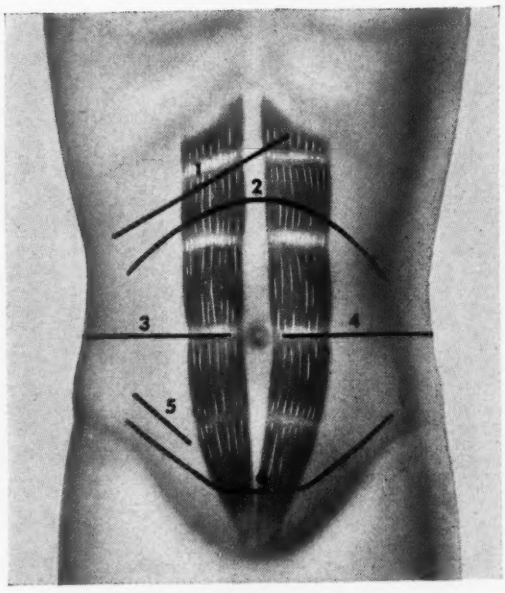
Learning is a constant, continuous and never ending process to members of the medical profession. New knowledge is sought as assiduously by the eminent and successful surgeon as by the humblest medical students. Through the discovery and presentation of new information regarding sutures and their use, Davis & Geck, Inc. seeks to perform a service of ever increasing value to the surgical world. In the following pages, some phases of this work, as well as certain aspects of D&G's production and quality control methods, are outlined briefly.

Incisions that Minimize Wound Disruption

AN IMPORTANT ADVANCE IN THE TECHNIC OF SUTURING



1. For gall bladder, common duct, head of pancreas.
2. Resection of stomach, transverse colon.
3. Resection of ascending colon, cecum, right sided lesions.
4. Descending colon, spleen and left sided lesions.
5. Appendectomy.
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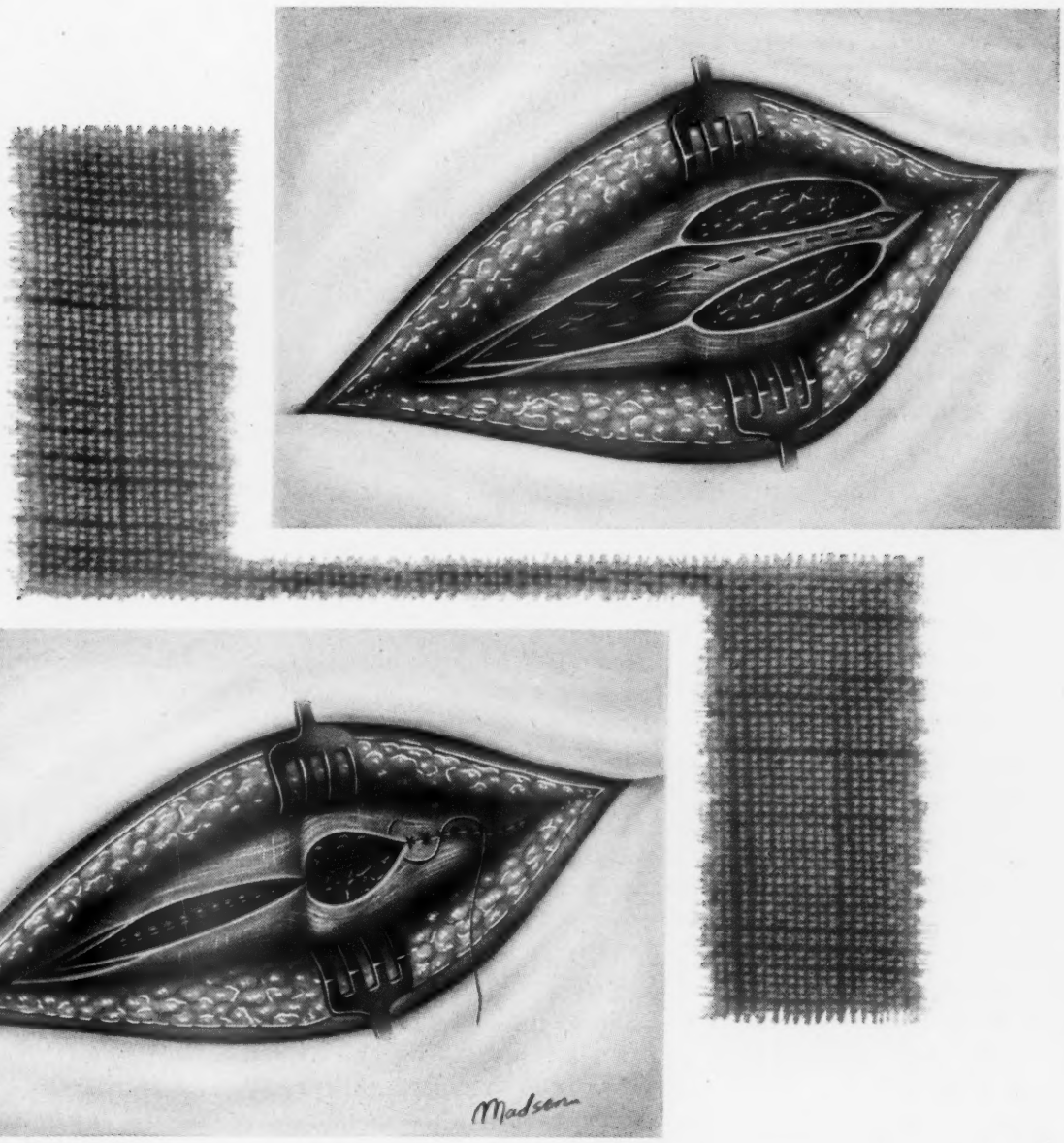

If the costal angle is narrow the incision is made two or three finger breadths below the right costal margin and parallel to it. It is made almost transversely if the angle is wide. The right rectus muscle is cut transversely. The left rectus muscle can also be cut if this exposure is needed. Each muscle contains one or two small arteries and veins of comparable size which require ligation. The lateral muscles are divided parallel to their fibres. The peritoneum and posterior sheath are incised in a direction parallel to their fibres. The falciform ligament is divided in the middle and usually contains a small vessel which requires ligation.

The incision is closed by approximating the falciform ligament first. Next the peritoneum and the posterior sheath are sutured with interrupted sutures. The posterior sheath is sutured separately in the region of the falciform ligament. The muscles are not sutured. The anterior rectus sheath is approximated with interrupted sutures. Size 000 or 00 sutures can be used in both the posterior and anterior sheaths while slightly larger sizes can be used in the linea alba. Very fine sutures, 00000 to 000, may be used in the subcutaneous fat if desired. Drains are placed at the lateral edge of the wound.

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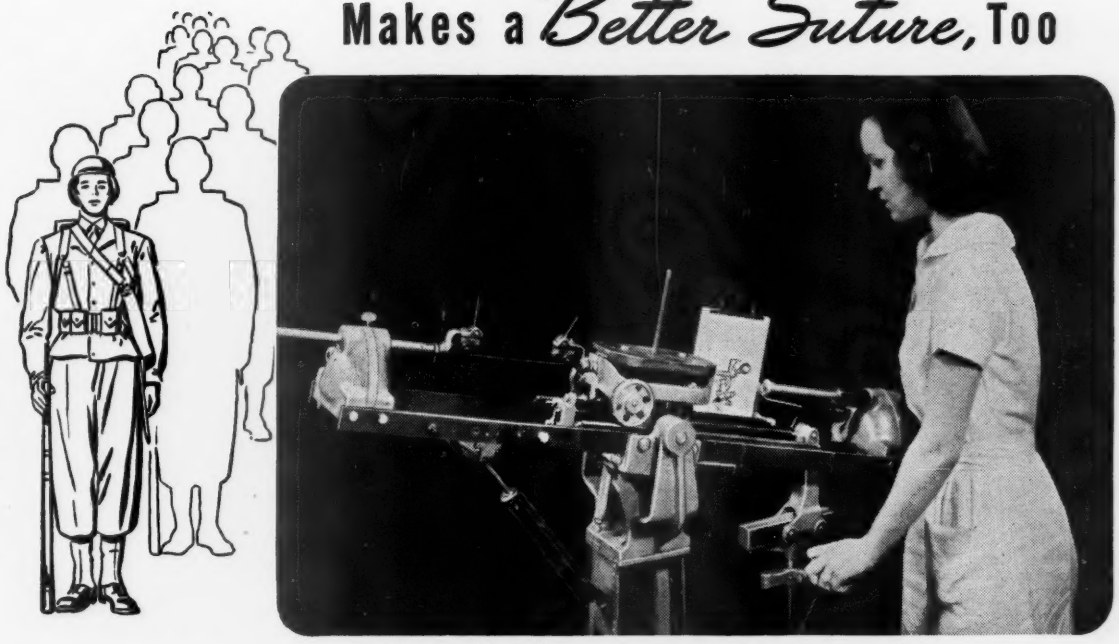

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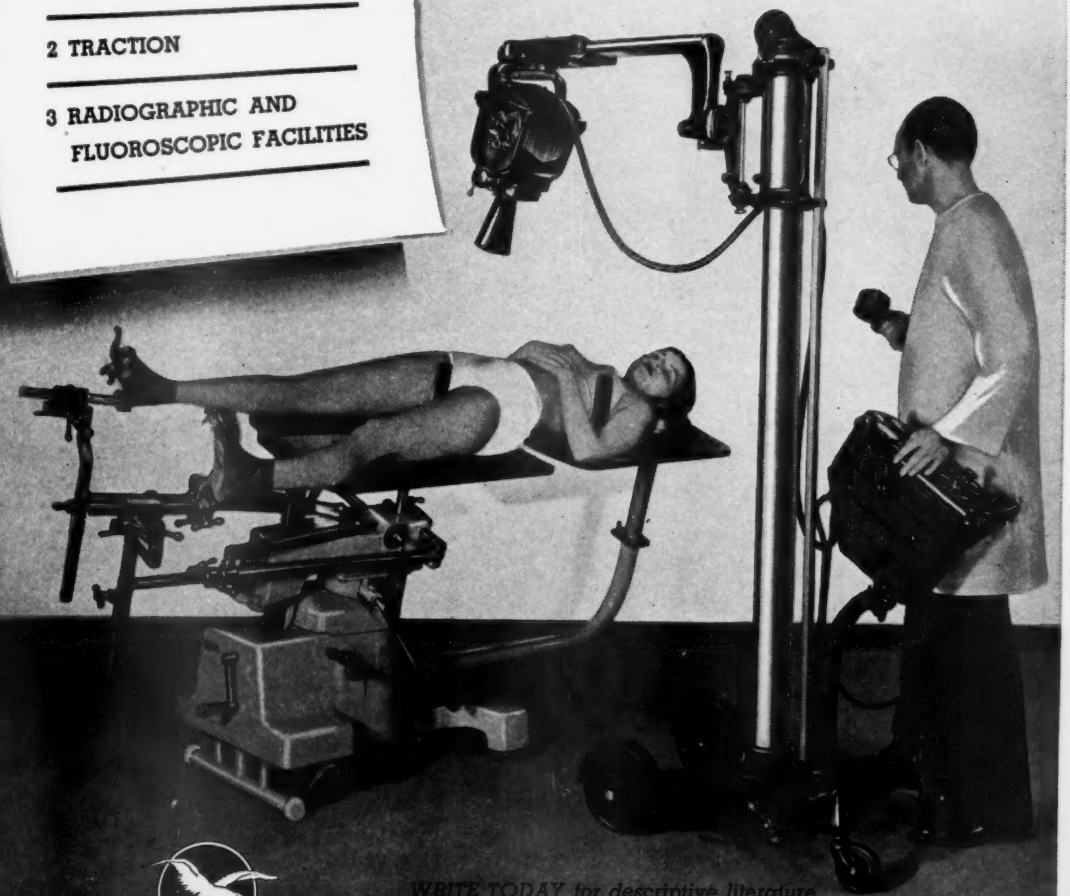

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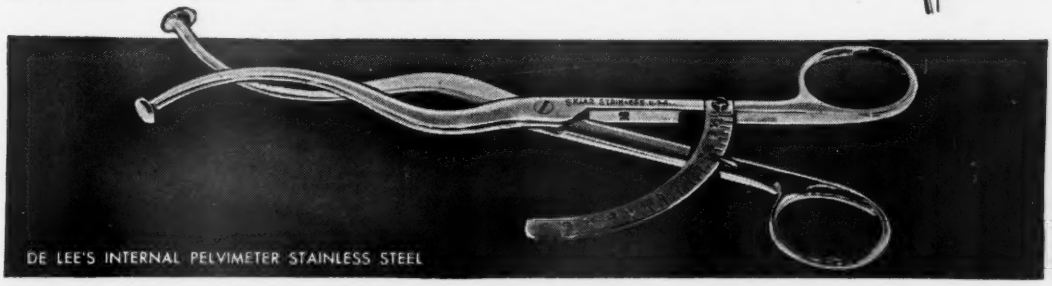

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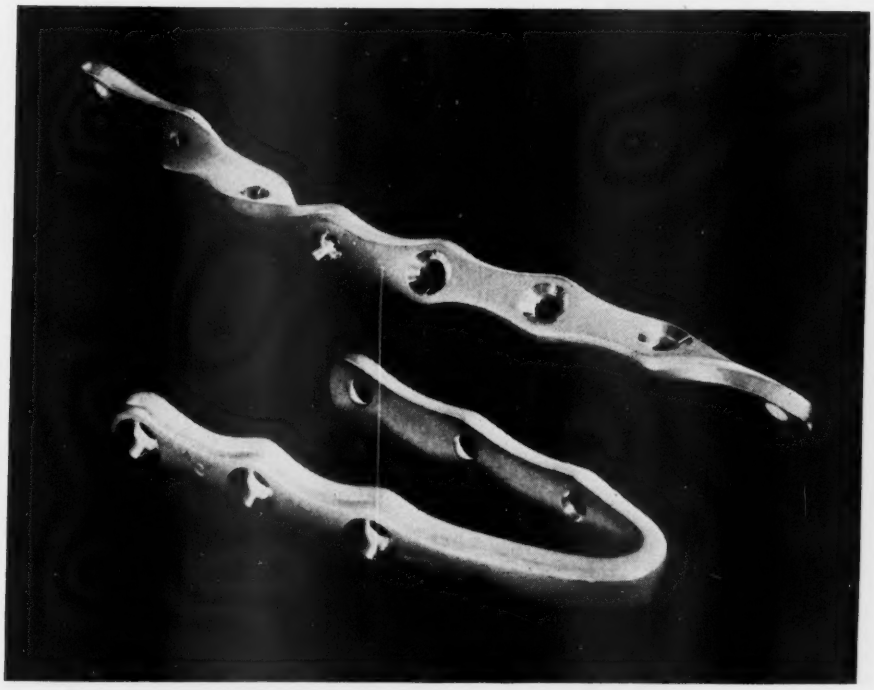

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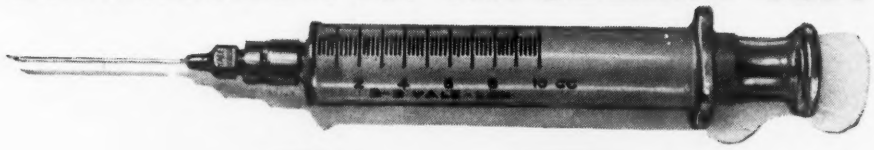

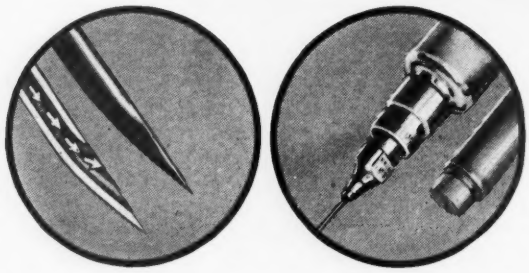

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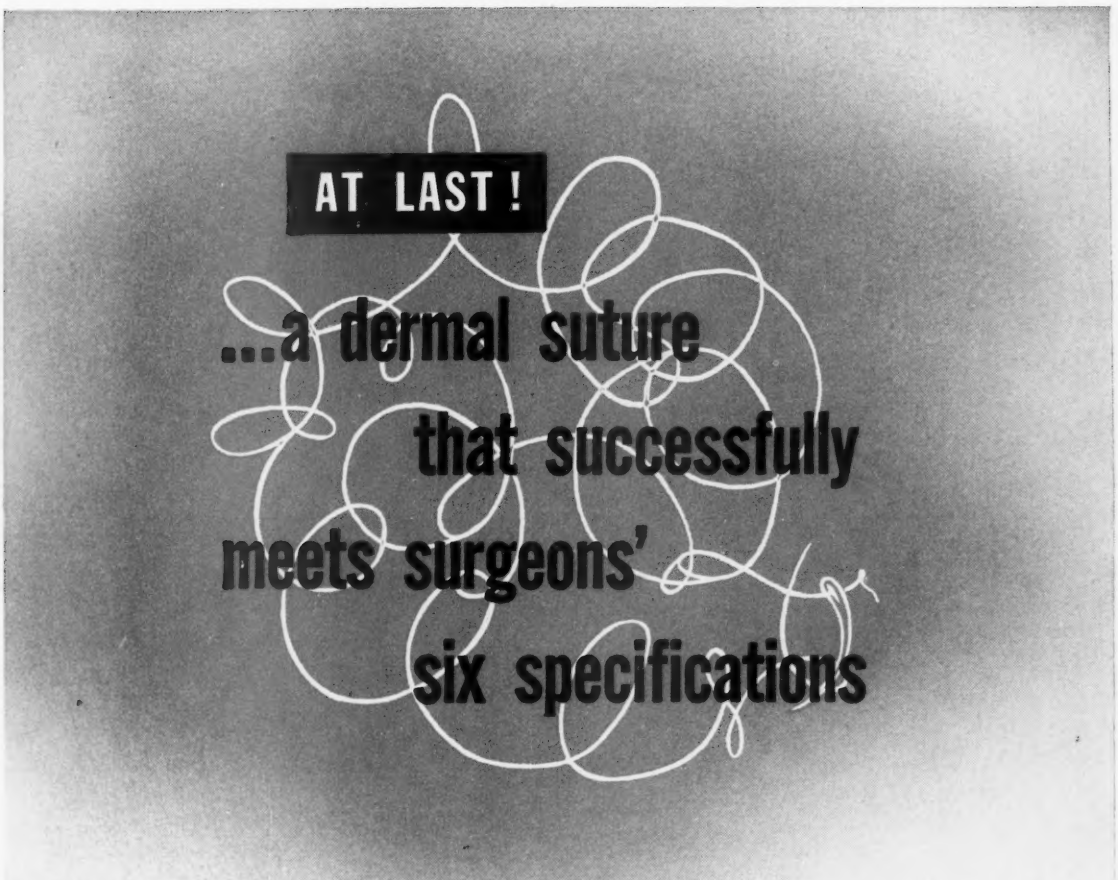

A recent survey was made to learn what specific characteristics surgeons sought in a dermal suture. It was disclosed that the six most essential qualities were: (1) softness and pliability for ease of handling; (2) easy removal *without pain;* (3) non-adherence to skin; (4) absence of cracking or fraying—no wound disruption or breakage when knots are tied; (5) ease in tying and non-slippage of knots; (6) tolerance by tissue with freedom from tissue reaction and wound infection.

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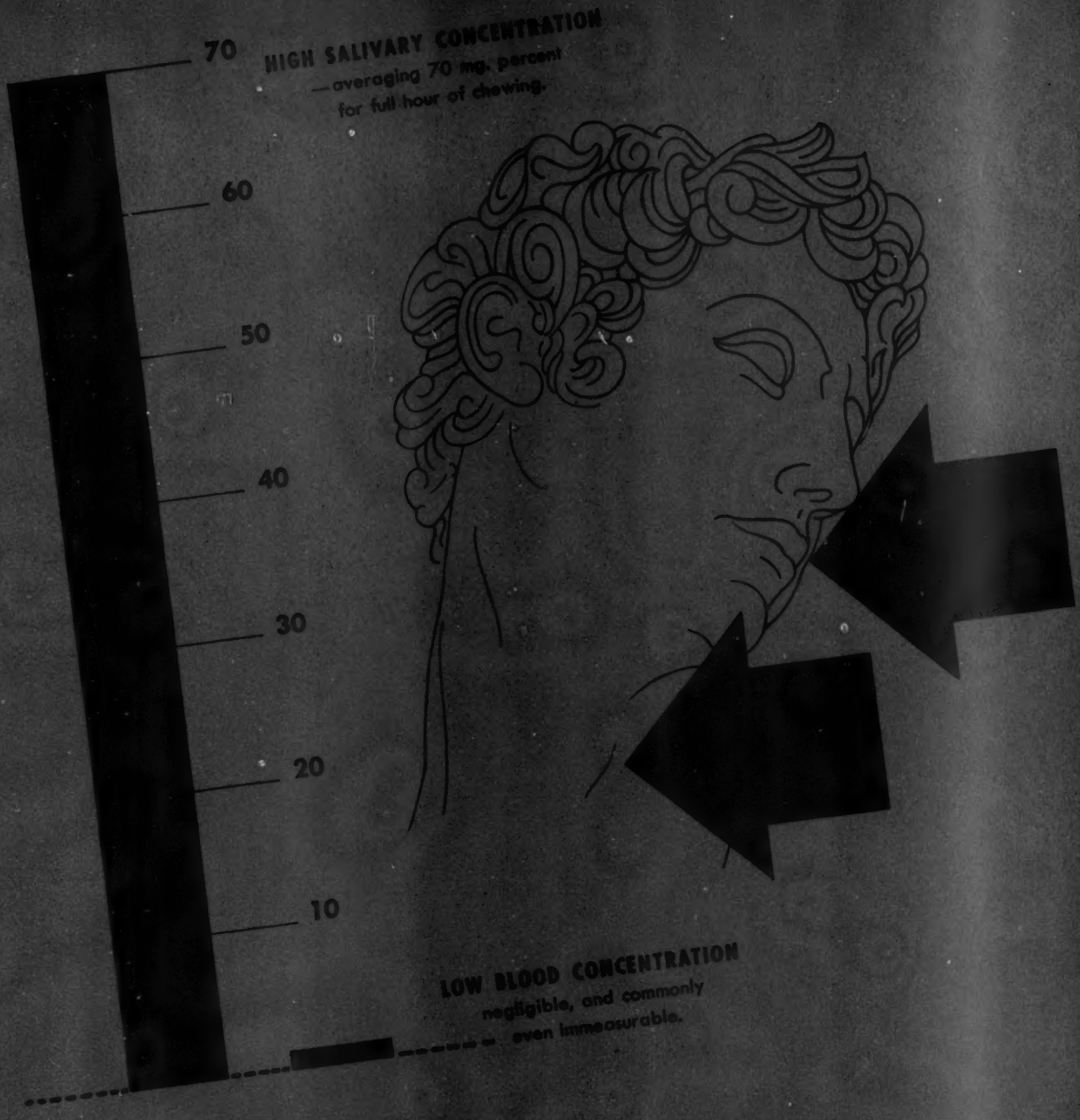

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Chewing even one pleasantly-flavored tablet for one-half to one hour:

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†*Fenton, Ralph A.: "Local Use of Sulfathiazole in Otolaryngologic Practice", Arch. Otolaryng., 37:491, 1943.*

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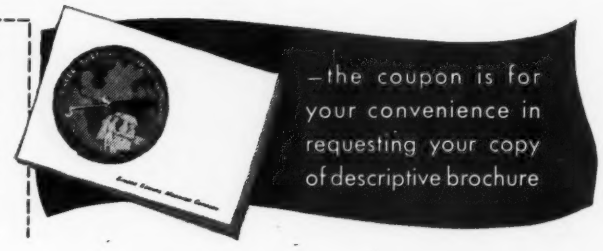

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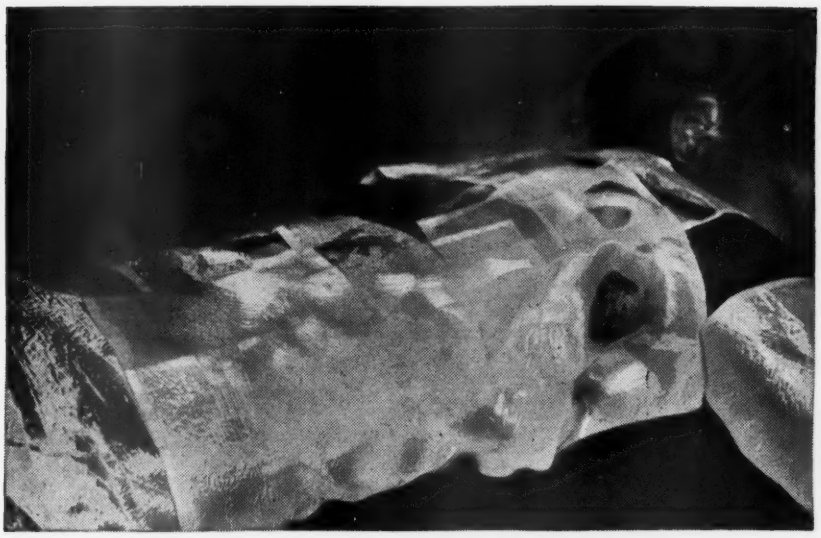

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Physicians, surgeons and others engaged in medical research have, in recent years, employed various Fiberglas materials experimentally and have found them uniquely fitted for certain uses.

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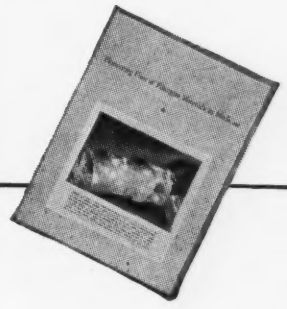

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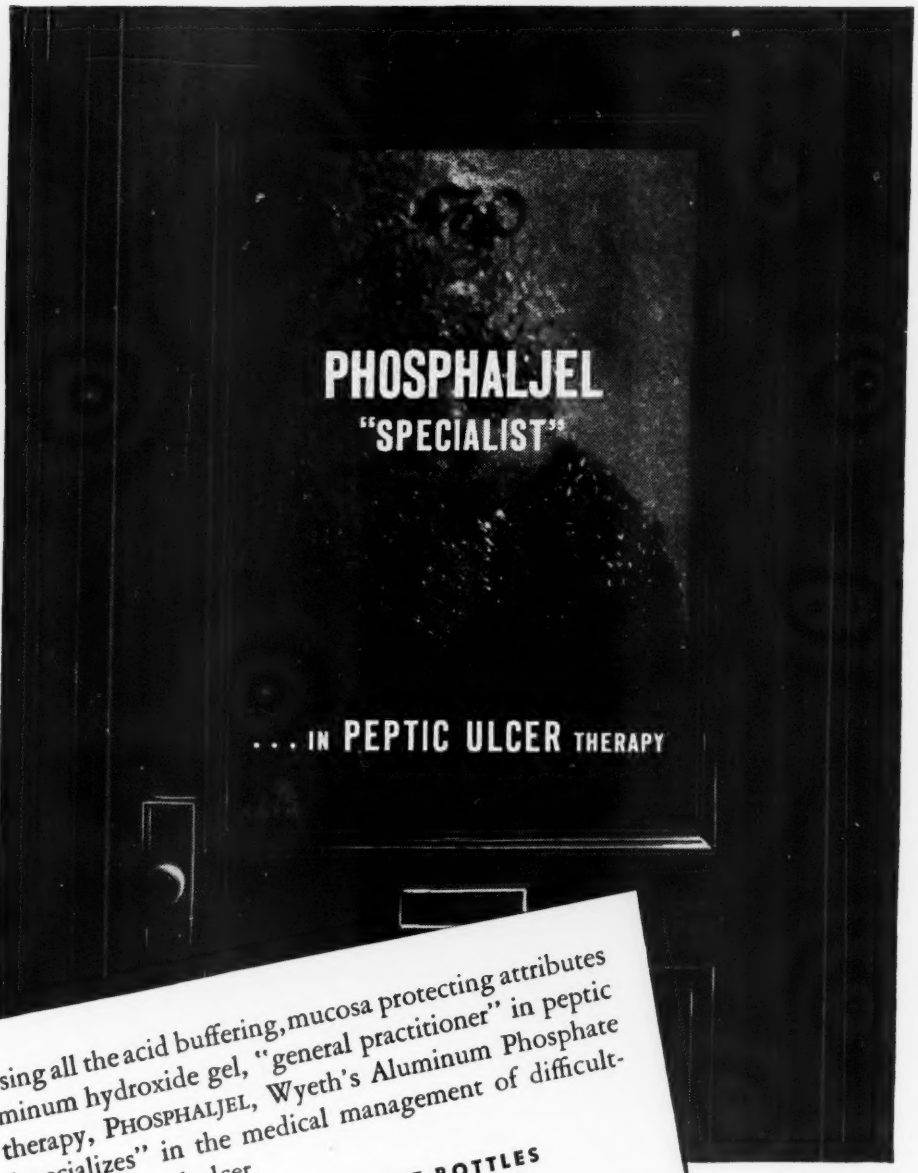

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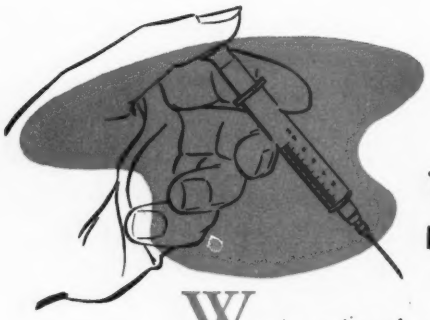

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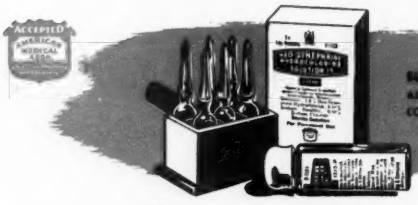

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*Rackberg, S.: *Anesth. & Analg.* 22:174, 1943.

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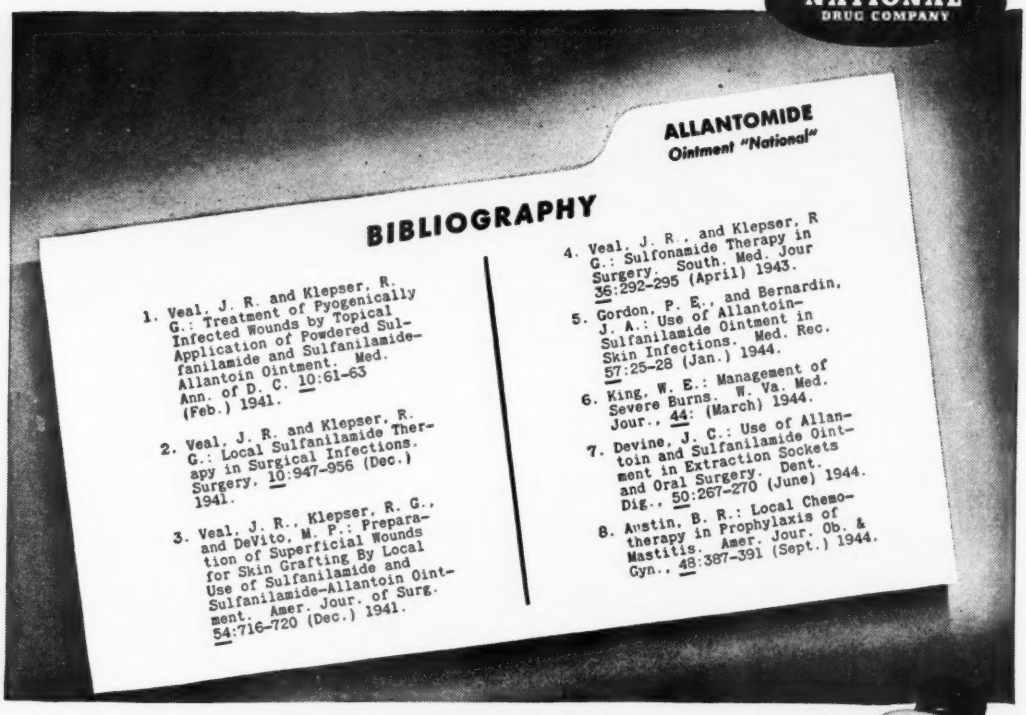
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4. Veal, J. R., and Klepser, R G.: Sulfonamide Therapy in Surgery. South. Med. Jour 36:292-295 (April) 1943.
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7. Devine, J. C.: Use of Allantoin and Sulfanilamide Ointment in Extraction Sockets and Oral Surgery. Dent. Dig., 50:267-270 (June) 1944.
8. Austin, B. R.: Local Chemotherapy in Prophylaxis of Mastitis. Amer. Jour. Ob. & Gyn., 48:387-391 (Sept.) 1944.

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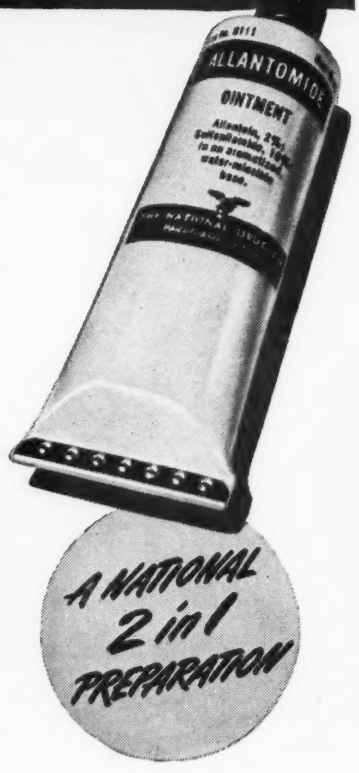

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*Kramer, G. B., and Sedwitz, S. H.: Ceepryn: clinical and bacteriological studies, Am. J. Surg. 63:240-245 (Feb.) 1944

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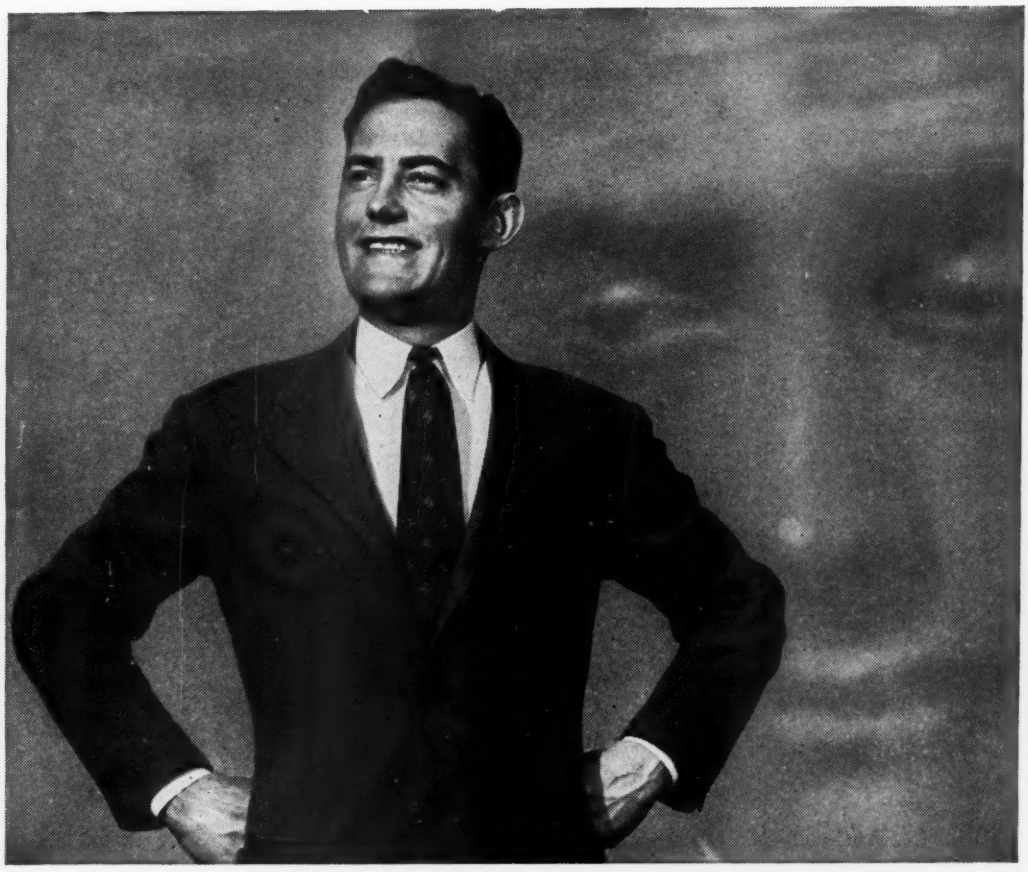

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Myerson, A.—*Anhedonia*—
Am. J. Psychiat., July, 1922.

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In acute infection without suppuration, acute infection with suppuration, and chronic infection involving bone, penicillin was found useful both preoperatively and postoperatively to control the infection, when used in conjunction with surgical drainage and other essential therapeutic measures.

Ferrer, J. M., Jr.: The Role of Penicillin in the Management of Infection, J. Bone & Joint Surg. 26:522 (July) 1944.

•

Five thousand units of penicillin every 4 hours for 10 days after adequate surgical drainage produced complete cure in osteomyelitis secondary to acute frontal sinusitis. X-rays taken one year later showed no evidence of osteomyelitis and revealed new bone growth.

Brody, B. S.: Osteomyelitis of the Skull, J. Connecticut M. Soc. 8:421 (July) 1944.

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The efficacy of penicillin in 440 cases of surgical infections is reviewed. The continuous intravenous administration of 60,000 to 150,000 units per day in patients with complicating staphylococcic bacteremia was usually followed by sufficient improvement to permit indicated surgery.

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Lockwood, J. S.; White, W. L., and Murphy, F. D.: The Use of Penicillin in Surgical Infections, Ann. Surg. 120:311 (Sept.) 1944.

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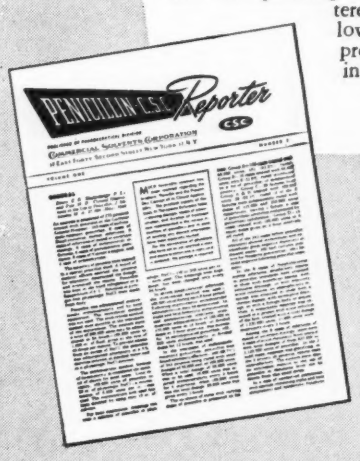
Conditions of interest to the traumatic surgeon, in which penicillin is of value: sepsis following attempted abortion, peritonitis following operation for a ruptured appendix, empyema, suppurating joints, sinus tracts, osteomyelitis, infected wounds, surface wounds and burns, deep wounds, cellulitis, infections of the hand, cavernous sinus thrombosis and infected thrombophlebitis, gas gangrene and compound fractures.

The value of early local and systemic penicillin and the necessity for indicated surgery are emphasized.

Priest, W. S.: Penicillin Therapy, Am. J. Surg. 67:280 (Feb.) 1945.



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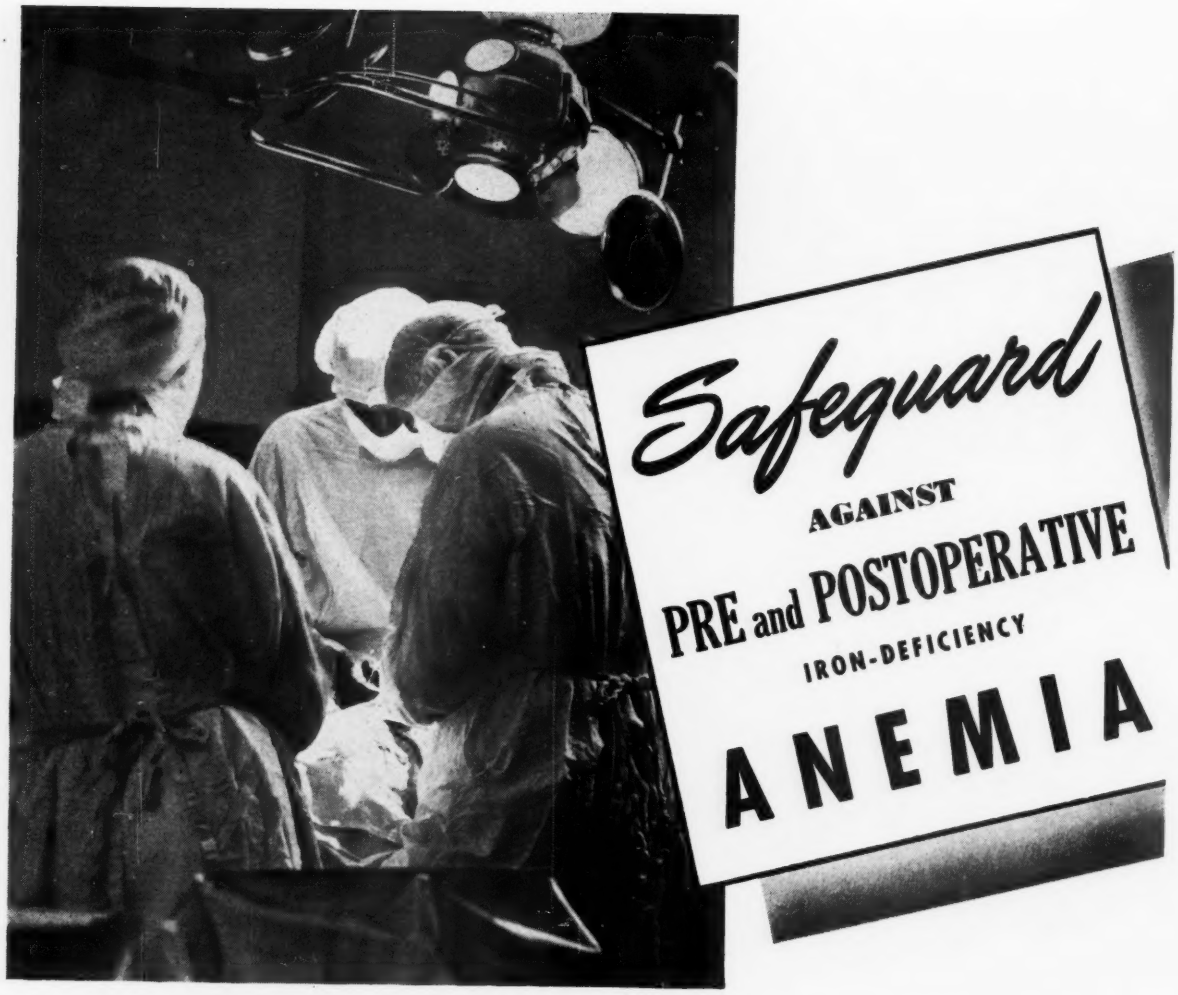

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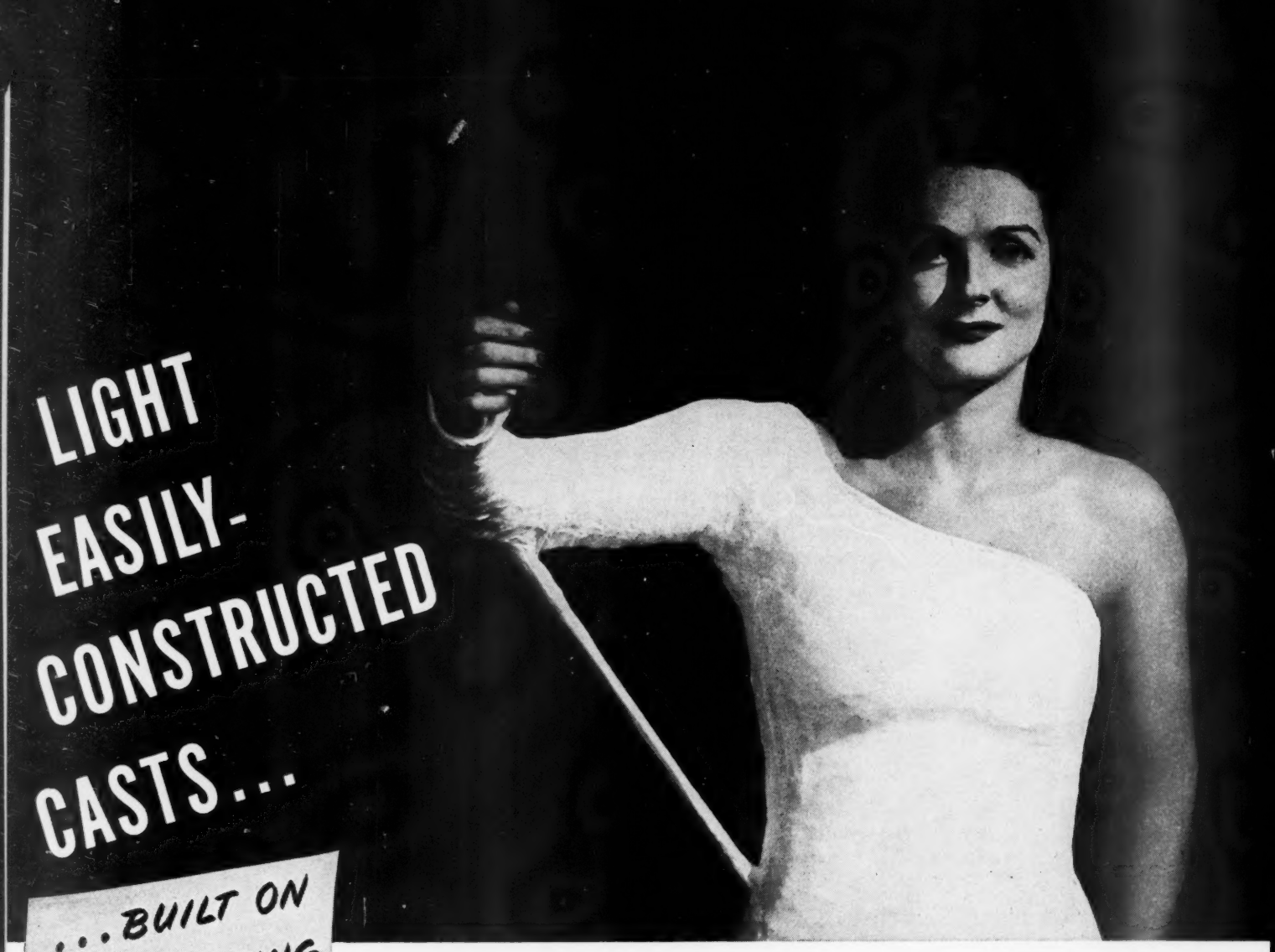

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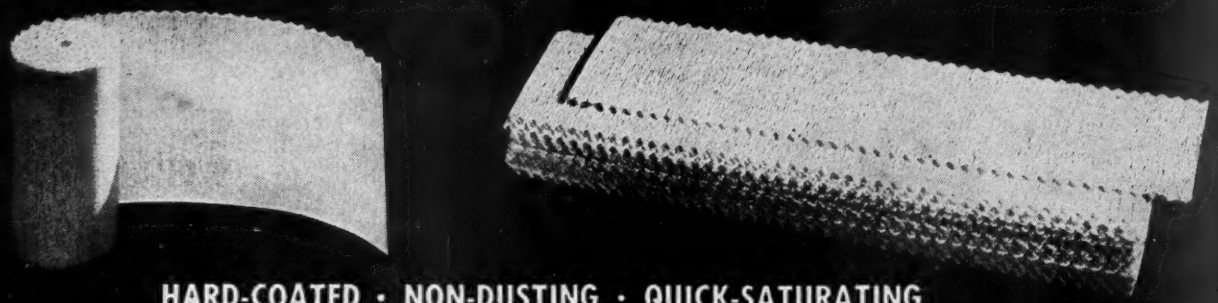

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Editorial

THE ARMED SERVICES AND MEDICAL EDUCATION

IN a paper read at the Conference on Medical Education in Chicago and published in the Journal of the A. M. A., February 16, 1918, Major Horace D. Arnold,[1] M.R.C., U. S. Army, suggested it would be possible to give three terms in twelve months, instead of two terms, as was the rule, in our medical schools, without any material detriment to the course of instruction. Dr. Arnold said, "The desirability of the general idea of speeding up medical education, without sacrifice of its quality, has the approval of the Surgeon-General."

In the June 1, 1918, number of the same journal, Dr. George Dock,[2] of St. Louis, replied to this suggestion for an accelerated medical course by saying the idea did not catch on . . . "There was very little discussion over this novel plan. Many of those who spoke left the main subject and dilated on the waste of time in vacations by teachers and students, the extravagance of empty class rooms, etc. . . . " In another part of his paper Dr. Dock continued, "All agree . . . that the present standard in medical education must be kept up, and that no concession should be made to those who raise the specious plea of war need to lower the standards of entrance and of graduation." Instead of lowering medical standards and jamming ill prepared men through a medical mill Dr. Dock offered the following suggestion: "Let the colleges retain their present terms until a better plan can be adopted. Send all medical students, about the middle of June, to camps of instruction and keep them there until a week or two before the fall term. In the first summer let the training be physical and military . . . In the second summer put the men in hospitals at training camps. Continue exercise, and train in the work of hospital orderlies, so as better to treat others . . . Part of the 'paper work' could be learned at this time. . . . In the third year, also in hospitals, as assistants, the more medical duties as well as 'paper work' could be finished. . . . At the end of the intern year (they proposed to permit interns one year of training) the young medical officer could at once take up his work, and be physically, militarily and medically much more useful than he is now."

We were told that due to the objections raised by Dr. Dock and other medical gentlemen interested in this subject, the three year medical education plan fell by the wayside. Dr. Dock's plan to train future medical officers during their vaca-

[1] HORACE D. ARNOLD, M.R.C., U.S.A., Washington, D. C. Medical education, medical interns and the war. *J. A. M. A.*, 70: 45, 1918.

[2] GEORGE DOCK, M.D., St. Louis. All year medical study and the education of medical officers. *J. A. M. A.*, 70: 1595, 1918.

tions was not accepted. From what we have heard and read concerning present day medical education, it is too bad someone early in this war did not exhume the papers and discussions on this subject published during the last war, and study them in a critical light. For, many physicians, especially those dealing with medical students or interested in medical education, believe that great harm, unnecessary harm, has been and is being done by the present hurry-up system or method of turning out poorly trained young men in medicine.

Dr. Evarts A. Graham in a recent issue of The Saturday Evening Post (January 27, 1945) wrote a pertinent and timely article on this topic, "Have the Armed Services Crippled Medical Education?" Because of his prominence and high standing in the profession one must give serious consideration to the many facts Dr. Graham presents in his thesis. We wish we could publish his article *in toto.* We hope most of our readers read it. At best we can only quote Dr. Graham in part and skim the highlights.

Dr. Graham opens his article by stating that although much has been said regarding our unpreparedness before Pearl Harbor, "In at least one respect, however, we were very well prepared. We had the largest group of the most splendidly educated medical specialists in our whole history. Thousands of these highly trained professional men were at once ready for mobilization and use by the armed forces. . . . They came immediately into the war, bringing the most up-to-date methods and techniques for the prevention of disease and for the treatment of the sick and wounded. . . . The professional work done by these medical officers has been extravagantly praised by many of the writers for the popular magazines and by the Surgeon General of the Army, Maj. Gen. Norman T. Kirk." We are told that 90 per cent of the wounded who reach the hospitals are saved.

All this is no surprise to those in the know. To those who have been engaged in medical education it has been only what was expected. The thing that surprises most people is the fact that the Army and Navy "have adopted policies which have already effectively prevented our medical schools and hospitals from continuing the supply of trained doctors for the armed services. . . . The public is too much inclined to think that the performance of medicine on the battle fronts has been due to the newer drugs and to the use of blood plasma . . . but valuable as these things are, they do not deserve the credit. Nor could any miracle gadgets in themselves achieve a record such as has been accomplished. It is the splendid civilian professional training in the various specialities of medical practice which is responsible."

The Surgeon General of the Army said, "The thing that's saving lives is surgery—surgery—surgery—plus plenty of blood plasma, penicillin and the sulfa drugs, and the fact that the whole setup was so well planned in advance."

Dr. Graham asks why it happened that these well trained medical officers were available to the Army and Navy immediately after our entrance into the war. He gave the answers: He traced the history and growth of medicine since the turn of the century. Medical education changed. The proprietary and fly-by-night medical schools closed forever. The educational requirements prior to beginning the study of medicine were raised. One had to have had at least two years of college work, mostly in the basic sciences before he was eligible to study medicine. The American College of Surgeons, founded in 1913, went about the business of grading hospitals and required minimum standards for recognition by the College, to the end that the intern would have a place for adequate or superior training. "Other branches of medical practice have organized for similar purposes . . . Under the auspices of the American Medical Association, fifteen specialty boards have been created, representing practically all the recognized spe-

cialties in medical practice." In this way young physicians in recent years have been of a well trained highly efficient order. In other words, they knew their "stuff."

With this in mind Dr. Graham observes: "One might suppose that a plan that has been demonstrated to be effective in the preparation of medical officers would be allowed to continue in order to supply replacements of the same caliber. But instead, it has been scrapped by the War and Navy departments. Paradoxical as it seems, the program which probably supplied the best prepared officers of any group of the civilian population to enter immediately into wartime activities has been destroyed, although we are constantly told that the end of the war is by no means in sight. . . . At the present time, every physically fit male medical student is destined to become a medical officer in either the Army or Navy. Despite the fact that laymen in the War and Navy departments who have no expert knowledge of medical education have specified what the premedical course shall be, and have caused the reduction of the faculties of the medical schools by about 40 per cent and the streamlining of the course, the undergraduates are receiving fairly good instruction, although not nearly so good as in the prewar days."

A directive was issued on April 3, 1943, that "after July 1, 1943, the total number of residents *permitted* for the hospitals of the United States shall not exceed 50 per cent of the number of residents on duty in the hospitals on July 15, 1940." No exception was made, . . . all hospitals were in the "same basket," the little country institution and the large teaching hospital connected with a medical school. It was further decreed that "The internship shall be reduced to nine months. One third of the interns who hold commissions in the Army and Navy may be deferred for nine months (10th to 18th months). One half of this number or one sixth of the total number of commissioned interns may be deferred for an additional nine months (19th to 27th months)."

This has since become known as the "9-9-9 plan."

The time tried and successful plan found to be efficient in producing well trained physicians and surgeons has been destroyed. The nine months' internship must be a rotating one. One had to divide during the nine months the following specialities . . . medicine, surgery, obstetrics, gynecology, psychiatry, dermatology, ear, nose and throat, pediatrics, and so on and on. As Dr. Graham observes, "Not enough of any of these subjects could be learned in that way to be dignified by the word 'smattering.'"

We are told that about two-thirds of all male interns (about 4,000) will enter active military service. Most of these men will have had at best but a few months experience in surgery. We read, "The Army lives by its tables of organization. Early in this war, we were told that it would need 6.5 medical officers for every 1000 men. This ratio was determined in time of peace, when only a small Army was contemplated. It was extravagant even then, but when an Army of 8,000,000 and a Navy of 2,500,000 were contemplated, it meant that 68,250 medical officers would have to be found, practically all from civil life—approximately 42 per cent of all the living graduates of medical schools, whether in active practice or not. It is a well known American characteristic that we react with almost hysterical violence to an emergency. The general philosophy of those responsible for this policy seems to be, "Better have a lot of poorly trained medical officers than fewer well trained ones."

Then Dr. Graham asks us to stick to cold statistics so we can see why a demand by the armed services for more than 40 per cent of the doctors of the country may be termed extravagant.

"The war casualties announced through November 7, 1944, comprise 88,000 Army

dead and 29,000 Navy dead, a total of 117,000 since the beginning of the war. By calculation from figures of the United States Public Health Service, there were from the beginning of 1942 through October, 1944, no fewer than 3,802,000 deaths—approximately thirty-two civilian deaths for each fatality in the services. Though this ratio is apt to diminish, civilian deaths will probably always be very much greater in number. Yet approximately only one half of the doctors were left for the home front.

When one compares only the number of deaths from accidents at home with those in the armed forces from combat, one finds, again on the basis of United States Public Health reports, that even the deaths from accidental causes in the United States, which are somewhat similar to war injuries, have been two and one half-times greater than those from combat.

What about the hundreds of thousands of seriously ill patients who are constantly in the civilian hospitals? The Army is proud of its record of low incidence of illness. Yet the Army medical officers have the finest physical specimens of young manhood in the country to deal with. Mortality from illness in that group should be lower than in any other. Moreover, they do not have to deal in any significant numbers with the greatest killers of all the causes of death—namely, heart disease, cancer and apoplexy, because, in general, those diseases occur after middle age. Also, in 1943 alone, there were approximately 2,500,000 births in this country. This represents a medical service almost exclusively handled by civilian doctors."

We are told that the British, the Australian and the Canadian armies have about half the number of officers per a given number of soldiers of our Army "and there is universal testimony that the sick and wounded in those armies have received excellent attention . . . We have been spending our capital. It would be more precise to say that we have blown it in all at once."

Dr. Graham concludes his article: "The future of American medicine requires a realistic approach to the needs of the Army and Navy, as well as the home front, for doctors—and not slapdash doctors, but doctors trained in the thorough manner which has given to American civilian and military medicine a leading position in the world."

We feel sorry for the lads in Army and Navy uniforms we see studying medicine these days. We feel sorry for them now; we feel sorry for them when they will become Officers in the Medical Corps working alongside of men a little older who were properly trained; and we shudder to think of them when the war is over and they return to civilian practice and life.

Dr. Graham intimates that laymen in the Army and Navy have been responsible for all this chaos in medical education, but we have heard it told [always off the record] that the blame can also be directed to some of the big high-hats in the profession who seem to be able to give the answers even before they knew the figures. Any way you look at it the three-year wonders in medicine who have graduated and will graduate will comprise the most poorly educated and trained group of many, many decades.

The other day we were told by the assistant dean of a medical school that the Army requires 2,000 more physicians, and the Navy must have 8,000 more.

T S W.

Original Articles

SURGICAL MANAGEMENT OF VASCULAR TRAUMA

CAPTAIN H. L. PUGH
MEDICAL CORPS, UNITED STATES NAVY

IN 1757, exactly ninety years after the death of William Harvey, William Hunter, older brother of John Hunter, first described arteriovenous aneurysm. Up through the years there appears to have been a fairly well sustained interest in trauma to and surgery of the vascular system. Each war has served to add a special impetus or boost to this interest. This was notably true of World War I, and is certainly true of the present war. The annals of medical and surgical literature have been enriched by many fine articles and reports upon the subject of vascular surgery, particularly during the last quarter of a century. At this very time, indeed, it is the rule rather than the exception to find an article on vascular surgery in practically any surgical periodical one may pick up.

A review of the literature on any subject preliminary to the preparation of a paper will usually do two things: First, it will add immeasurably to one's store of knowledge, and, second, it will reveal that a wholesome difference of opinion has prevailed upon various points in the minds of those who have individually contributed to that literature.

Prior to the entry of the United States into the current war, my personal experience with the management of vascular injuries had been practically nil. To date my experience comprises the handling of thirty cases in which arterial and arteriovenous trauma constituted the paramount disability.

It seems that when one comes to write upon a medical or surgical subject, whether his stimulus belongs to the category of inspiration or provocation or whether he is just naturally possessed with a furor scribendi, there is a more or less generally accepted method of approach preliminary to the follow-through, all of which may be summed up in the one word—orthodox. Thus, having selected a title, a brief comment may be made by way of defining just what is supposed to be implied by that title and so, since my title is "Surgical Management of Vascular Trauma," it would appear right and proper to amplify this idea further by stating that I propose in the main, or primarily, to discuss traumatic arteriovenous fistulas or aneurysms, with some reference to etiology and to the symptoms and to the local and semilocal manifestations and to the systemic phenomena produced by these lesions, and lastly I shall come to a consideration of their surgical management. Such reference as I shall make to arterial trauma or accident *per se* will be secondary and for the sake of adding a little variety.

Suffice it, therefore, to say that in general arteriovenous aneurysms comprise two classes: first, true, and second, false; and since traumatic aneurysms belong entirely to the second class, the first, so far as this discussion is concerned, may be dismissed.

False aneurysms or aneurysm spurum occur usually as a result of direct injury, such as bullet, shell fragment, or stab wounds. One exception is the carotid cavernous sinus fistula, which may be caused indirectly by a fractured skull. The peculiar anatomy of the region makes this possible. This is the only place in the body where an artery is surrounded by a vein,

as has been pointed out by Penick.[1] We have in our series had one case probably belonging in the category with carotid cavernous sinus fistula. If the artery and vein communicate directly, such a short circuiting is classed as an aneurysmal varix or Potts aneurysm. If there is an intervening sac, a varicose aneurysm is said to exist. The time interval between the infliction or acquisition of a wound and the development of an aneurysm varies from immediately to weeks or even months.

Pathogenesis. The genesis and subsequent development of an arteriovenous fistula appears to be based upon fairly simple principles and will depend to some extent upon the character of the original wound. If, for example, a bullet or piercing instrument passes between an artery or vein lying in close proximity to each other, a nick in both vessels may result in the immediate shunting of the arterial blood into the vein, with very little extraneous hemorrhage and hematoma formation. In the majority of cases, however, there is spillage of a variable amount of blood, with a consequent hematoma which may be very well delineated by the surrounding structures or, on the other hand, this hematoma may extend along fascial planes or dissect into the soft tissues until it attains a considerable size. In any event, when the spread is ultimately arrested, a process of absorption and organization ensues and with the laying down of fibroblasts and connective tissue, a retaining wall or sac is formed. As time goes on this sac becomes lined with the same type of endothelium as constitutes the intima of the artery and its structure acquires a tough, elastic quality. Depending upon the resistance of the surrounding structures and also upon the nature of the break of the vessel walls, this sac can assume a variety of shapes. It may be single and symmetrical or it may be very asymmetrical and multilocular. Or there may be two more or less separate sacs, one communicating directly with the artery and the other with the vein. Numerous collateral vessels usually communicate with the sac.

Symptoms. The subjective symptoms related to an arteriovenous aneurysm are reasonably constant in quality although the degree of such symptoms will vary depending upon the location and size of the lesion and upon possible concomitant nerve involvement. Pain of a tingling or burning nature extending along the affected extremity and numbness and a coldness of the extremity are the more common subjective symptoms.

Signs. The objective signs fall into two distinct classes: first, those elicited locally, and second, those regarded as systemic phenomena. Locally there are three classical signs which when present are pathognomonic of an arteriovenous aneurysm. They are (1) pulsating tumor, (2) thrill, and (3) bruit. The pulsation, when present, is characteristically expansile in type and is indicative of the presence of a sac. When a simple fistula exists without an intervening sac, a pulsation may not be felt. The thrill is a sensation imparted to the palating hand and is similar in quality to that produced by a purring cat. A bruit is an auscultatory sign and has been likened by Moorhead[2] to the buzz of machinery, the droning of bees, the whirr of a bird in sudden flight or the humming of a top. All three of these signs reach their crescendo during systole. They may all be reduced or made to disappear entirely by pressure on the tumor or proximal to it, provided, of course, the tumor or fistula is accessible. Position may likewise change the intensity of these signs. Pressure over or proximal to the tumor will moreover produce a slowing of the pulse. This bradycardia was recognized and described in 1890 by Branham, an American surgeon, and is generally referred to as Branham's sign, although at least one writer, Pratt,[3] refers to this manifestation as Paré's sign. Actually Nicaladoni is credited with having first described this finding in 1785.

The systemic phenomena produced by an arteriovenous aneurysm are several and

a contemplation of their cause constitutes one of the most fascinating aspects of this subject. As would be perfectly natural to expect, the chief changes wrought by this vascular short circuit are reflected in the circulatory system. A basis for an appraisal of the extent the arteriovenous fistula is affecting the general circulation will be afforded by a study of these systemic manifestations. Moreover, such a study will reveal a close interrelationship among and between the various phenomena and the a priori sequence becomes readily apparent.

To list these changes more in the order of their cause and effect relationship rather than in the order of their seriousness, we may as well begin with:

1. An accelerated heart rate. This, it may very logically be assumed, is due, to express it rather metaphorically, to a physiological call on the part of the affected extremity or region for more and better blood. In response to this call the heart beats faster.

2. Hand in hand with the accelerated heart rate and perhaps to some degree a consequence, the second systemic change presents itself, namely, that involving the blood pressure. The systolic pressure tends to become elevated and the diastolic to become lower, thus the pulse pressure is increased.

3. This coincides with and both directly and indirectly explains and is explained by the third systemic change or an increase of the cardiac output with a decrease in the stroke output.

4. An engorgement of the pulmonary vessels may be mentioned as No. 4 on the list of systemic manifestations or effects and the reason seems obvious.

5. The venous pressure and circulating time are increased. The reason is again obvious.

6. The demonstrability of an increased circulating blood volume has been claimed (Holman and Shen[4]). This, however, was not confirmed by Reid and McGuire.[5] In any event, no more than academic interest, it would seem, need be attached to this latter point. However, that the several cardiovascular manifestations do lead to a very important consequence is inevitable and natural.

7. This consequence is that of damage to the heart itself—cardiac dilation or hypertrophy. This, it can be said without reservation, is the most deleterious systemic effect, complication or sequel of arteriovenous fistulas. While usually regarded as a late manifestation it may come on amazingly early. Mason et al.[6] reported an arteriovenous aneurysm which ended fatally on the fourth day following a stab wound in the supraclavicular fossa. The cause of death as revealed by clinical observation and autopsy was cardiac decompensation. The explanation for damage to the heart can be found wrapped up in the several circulatory phenomena enumerated, though if reduced to simple terms the explanation may be said to be fundamentally twofold: First, the shunting of arterial blood into venous channels through the fistulous opening leads to an overfilling and dilation of the right side of the heart. It follows naturally that the larger the opening, the larger the amount of blood shunted, the greater the overfill and the more rapid the dilatation. The second factor in cardiac hypertrophy (and actually this factor is more conducive to hypertrophy than to a simple dilatation) is that of overwork (McGuire[7]). Because of the set of circumstances responsible for the accelerated rate, the elevated systolic pressure, the increase in the cardiac output, etc., the heart is laboring under difficulties and is working overtime day and night. Here again the size and location and duration of the fistula are important considerations.

8. Early evidence of cardiac damage due to arteriovenous aneurysm can be detected by an electrocardiographic tracing.

Semi-local Changes. Still related to the circulation but separate from the manifestations involving the heart, certain changes occur locally or in the immediate

vicinity of an arteriovenous shunt. The most important of these changes is the establishment of a collateral circulation which in some instances is indeed striking. That the establishment of such a circulation is stimulated by the presence of a fistula far and above that which occurs following the ligation of the main trunk of an artery was pointed out by Dr. Mont Reid[8] and is a well established fact. This in itself poses a phenomenon more amazing perhaps than any other associated with the whole subject of arteriovenous aneurysm or fistula. The most plausible explanation for this interesting truth is, so far as I have found in the literature, offered by Dr. Emile Holman[4] who refers to Dr. Reid's early work. The most important factor, according to Holman, appears to involve the element of lessened resistance to the flow of blood in the area adjacent to and surrounding the site of the fistula. Normally considerable resistance is offered the flow of blood by the capillary bed through which it must pass. Because there is a fistula, the capillary bed is bypassed and the resistance to the flow of blood is lessened, and because the resistance is lessened in the arterial tree a greater amount of blood is attracted to the site through all available channels including the collateral vessels. It is likened by Holman to an attempt at appeasement of the thirst of the fistula by an opening up of all avenues leading to it. This is particularly marked if the fistula is large. This lessened resistance and increased flow of blood incident to the abnormal communication undoubtedly accounts for another extraordinary development and that is the dilatation of the artery distal to the fistula (Holman[9]). The proximal artery may also show thinning and dilatation and the size and length of the extremity may increase (Reid and McGuire[5]). The several latter factors are by no means constant and will depend in no small measure upon the duration as well as the size of the fistula.

Other variable manifestations contingent upon factors too obvious to warrant detailed discussion are: (1) Venous stasis leading to marbling of the skin overlying the region of the fistula; (2) increasing varicosities; (3) trophic changes; (4) associated nerve paralysis, and (5) limitation of joint motion. This is particularly prone to accompany a popliteal aneurysm and is almost always due to a concomitant injury to the joint or the peri-articular structures by the same agent which caused the aneurysm rather than to the presence of the aneurysm *per se*.

Treatment. We now come to the phase of the subject about which most of the expressed difference of opinion exists, namely, the treatment. But before entering upon a discussion of the determinate or specific treatment of the aneurysm itself, it would seem fitting and timely to comment upon certain general principles which by reason of either an indirect or direct influence may very appreciably effect the complexion of the situation.

1. In this category would come the *treatment of shock* in acute recently injured cases and mention is made of this for the sole purpose of calling attention to the fact that in shock the blood pressure is lowered and in vascular trauma ischemic gangrene is a prime threat. A lowered blood pressure and lowered temperature incident to shock tends further to predispose to tissue death in the involved extremity. Therefore, it is of especial importance to guard against and combat shock.

2. *Keep the patient warm.* Warmth encourages vasodilatation. Beware of hot water bottles and heat cradles. Impairment of circulation leads to increased vulnerability of the part to heat or trauma from pressure. It is extremely easy to blister an extremity in which the threat of gangrene impends by the careless use of heat. It has been moreover contended that heat increases metabolism in an area the circulation of which is already incapable of meeting the local demand, therefore, on this score heat is bad. Cold causes vasoconstriction and so is that bad. In any event, common sense dictates warmth

within reason. Alcohol is a vasodilator and so predicated is sometimes prescribed. It will do no harm and may do good.

3. The *extremity should be kept elevated* but not excessively so. The best height should be determined by the position of maximum comfort to the patient. This will usually be found at a level slightly lower than that of the heart. The extremity should be allowed to rest on soft pillows. Pressure or trophic ulcers are always a definite menace.

4. It is a well established fact that *injury to a large blood vessel is accompanied by a pronounced spasm*, not only of the injured vessel but also of the associated collaterals. If it were not for this fact, death from hemorrhage would be far more common (Ochsner[10]). The sympathetic nervous system controls this spasm. An interruption of the sympathetic influence by either the injection of procaine or alcohol into the nerve chain or surgical section of its ganglia will eliminate and make such spasm impossible. Based upon this concept, plus the repeated observation of actual and striking results, the interruption of the sympathetic nervous system by either injection or section has become an almost routine adjunct in the management of vascular trauma in some clinics, particularly that of Dr. Alton Ochsner of New Orleans. We have not resorted to section here but have employed injection of procaine in either cervical or lumbar sympathetics in a number of cases. There is no question as to the efficacy of this measure.

5. The *cessation of the arterial circulation* will lead to dry gangrene. It is a cardinal surgical principle to keep dry gangrene dry, therefore, avoid wet dressings.

6. The importance of the *care of the local wound* should not be overlooked. If it is infected, treat the infection according to sound surgical principles and do not attempt repair of an aneurysm until every evidence of infection has definitely subsided.

7. When operating, *employ the most meticulous aseptic technic.* A successful outcome will depend upon the avoidance of sepsis as a first requisite.

Upon reviewing the literature relative to the definitive treatment of arteriovenous aneurysm as it has appeared in the various surgical periodicals and upon consulting a number of text books, one must gain the impression that the fundamental concepts and doctrines preached vary, depending upon several factors, the chief among which are whether or not the author is writing an article in conjunction with a series of patients he has personally treated and is reporting upon, or whether the author is writing a text book or section thereof.

Generally speaking, the author of the article which supplements the report of a group of cases will emphasize a single, clear-cut method which produced satisfactory results in his series. The author of the text book will describe a number of methods and will in all likelihood adopt a conservative or middle of the road attitude. On two points in particular it is startling to note how at variance is the concept laid down by several text book authors, with that of authors who report upon a large number of personally conducted cases. I refer in the first instance to the matter of ligating or not ligating the accompanying vein when a large artery is ligated. Hermann and Reid,[11] for example, stress the importance of ligating the accompanying vein: "We cannot too strongly condemn the procedure of simple ligation of the involved artery at a point proximal to the fistula." Reid and McGuire[5] further amplify this contention:

"An untold number of limbs have become gangrenous and have had to be amputated because of the simple proximal ligation of the artery. It is far more dangerous than the ligation of an artery for an arterial aneurysm for the shunt or spillway remains and there is no longer enough arterial force to push the blood beyond it."

Thorek[12] stresses the importance of preserving the vein: "In important vessels, ligation of the vein carries with it the danger of gangrene, therefore preservation

of the vein in arteriovenous aneurysm plays a signal role."

The second matter about which a difference of opinion is conspicuous entails a condemnation by some of quadruple ligation and excision of the sac (Warbasse and Smyth[13]): "The vessels may be ligated above and below the sac and the sac excised. This is usually an unnecessary amount of traumatism and is rarely indicated. This quadruple ligation usually constitutes an unnecessary sacrifice of vessels and should when possible be substituted by clamping the vessels, excising the sac and suturing the vessels from within." Others, notably Moorhead,[2] Holman,[16] Herrmann and Reid,[11] and Waugh and Neel,[14] have repeatedly stressed the applicability, the comparative simplicity, and the gratifying results obtained upon quadruple ligation and excision.

The second factor which appears to have a bearing upon the prevailing trend in the management of arteriovenous aneurysm is the medical school which the author attended or section of the country or world wherein he has practiced. New Orleans, for example, has for long been thought of as an oracle on vascular surgery. This, of course, has been due to the great influence there of the illustrious Dr. Rudolph Matas. His proteges are many and in many respects are imbued with similar ideas, all emanating from Dr. Matas. In New England there is another school of thought not necessarily different but nevertheless separate, centered around Harvard and the Lahey Clinic. In New York and Philadelphia there are in-between schools which can claim a number of great progenitors, including Dr. Moorhead and the immortal John Chalmers Da Costa. In the Midwest, Dr. Crile's Clinic in Cleveland, the Mayo Clinic at Rochester and that of the late Dr. Mont Reid at Cincinnati, have for long radiated the highest surgical concepts to the four corners of the earth. On the west coast, I know of no one who has contributed more to the advancement and solidification of ideas relative to vascular surgery than Dr. Emile Holman, late of Stanford University and now a captain in the Medical Corps of the United States Navy. For those who may still believe that the last word has not been spoken until Europe has been heard from, reference may be made to Paul Delbet of France. As long ago as 1889, when modern surgery was in its early infancy, Delbet, after having studied 695 cases of arteriovenous aneurysms, recommended that all indirect methods which at that time enjoyed great popularity be discarded, and that ligation and extirpation of the sac be substituted therefor.

The third factor which will be seen to influence in no small measure the principles and practices advocated in the treatment of arteriovenous trauma will be contingent upon whether the proponent is a civil or military surgeon. If civil, the inclination will likely be toward conservatism and the more involved methods. If military, the inclination will be toward early operation, a simple method and expeditious conclusions.

The many surgical procedures which lend themselves to the treatment of the various types of arteriovenous aneurysms and fistulas have been repeatedly described in many surgical magazines, systems of surgery and text books, and for the purpose of this paper need not be reviewed. The essential objective is that the passage of blood from the artery to the vein through a fistula be completely and permanently prevented.

Granted that a few arteriovenous fistulas and traumatic arterial aneurysms may disappear spontaneously or under some physicotherapeutic regimen such as Vanzetti's method, certainly the great majority will not, and such conservatism is not likely to be compatible with the exigencies of the military service. On the other hand, too early surgical intervention is definitely fraught with risk. It must be agreed that a minimum of two or preferably three months must be allowed to elapse in order that the collateral circulation will have had a

chance to develop. Undoubtedly this will require less time in young, vigorous men than in older individuals.

There are certain methods of testing the collateral circulation published by Dr. Matas in the Journal of the American Medical Association many years ago, and are listed under Treatment of Aneurysms in Dr. Da Costa's text book of Modern Surgery,[15] Any of these or other methods may be employed.

Suffice it in any event to say that in the series of twenty odd cases done at this hospital, not more than six months elapsed in any case (save one) and much less in several between the infliction of the wound and the operation for vascular trauma. A quadruple ligation with excision of the fistula was done in twenty cases of arteriovenous aneurysm. Paravertebral injection of the lumbar sympathetics or cervical sympathetics was employed in nineteen cases. There was no incident of gangrene of the extremity in nineteen cases. One case, however, (Case E.B.L.) promptly developed gangrene despite all efforts to forestall it and amputation of the leg above the knee was necessary. The arteriovenous fistula was of two and a half years' standing in this case. Certain extenuating circumstances described in the case report undoubtedly contributed to this tragedy. In one case of popliteal arteriovenous aneurysm in which the artery alone had been ligated, there was a grave threat of gangrene, however, prompt ligation of the vein was followed by an immediate improvement of the circulation and gangrene was averted. In one patient in whom the axillary and axillary circumflex arteries had been severed by metal fragments, ligation of the arteries alone was promptly followed by a dry gangrene which later necessitated an amputation of the arm above the elbow. This case is exclusive of the series of twenty arteriovenous aneurysms above referred to, since in this instance the trauma involved only the large arteries. It is believed that this arm might have been saved if the axillary vein had been ligated concurrently. This, of course, is purely speculative and it might be added here that a concomitant gross trauma of the surrounding soft tissues is an additional predisposing factor to gangrene of the extremity below such trauma. This type of tissue damage obtained in the case in question.

Recovery from such disability as could be ascribed to the arteriovenous aneurysm was complete in every case. All returned to full or limited duty, unless a separate and distinct additional encumbrance forbade.

The experiences of those who have actually had occasion to deal first hand with an appreciable number of cases and certainly the experience of those who are today handling an increasing number incident to the war tends more and more to substantiate the opinion shared heartily by this writer, that quadruple ligation and excision of the involved segment is the treatment par excellence for arteriovenous aneurysms or fistulas. However, that this procedure should not be resorted to with impunity and that the development of gangrene and the loss of a limb may supervene is a fact to which we can unreservedly attest.

The futility and disadvantage of using a tourniquet in the surgical management of arteriovenous aneurysms has been spoken of by a number of writers—Reid and McGuire and others. Certainly in our experience the control of bleeding even after a quadruple ligation has been done has at times been distinctly difficult. To obtain hemostasis so perfect as to permit detailed and methodical repair of these lesions has appeared impossible.

In a recent article by Dr. Emile Holman[16] three notable points have been stressed: One is the feasibility of or advantage to be gained by resection of the clavicle when an operation upon the subclavian vessels is necessary. Another is the importance of gaining control of potentially dangerous hemorrhage by exposing and temporarily arresting the flow of blood through the

common and external iliac vessels when operating upon a lesion in the femoral area. A practical method of exposing the iliac vessels extraperitoneally is described by Dr. Holman. A third matter stressed in this article is the rationale for ligating the main artery just distal to an important collateral proximally and just proximal to an important collateral distally. In other words, the avoidance of dead ends or functionless segments is regarded as important.

We have not resected the clavicle in any of our subclavian fistulas but we have exposed and placed slings of rubber dam tubing around the iliac vessels in four of our femoral aneurysms, and we have observed the principle of ligating near collaterals where this has been possible.

The danger of ligating a large vessel in elderly patients with damaged hearts has been spoken of by Reid and McGuire[5] and the advisability of gradually accustoming the heart to a permanent closure of the fistula by repeatedly occluding the vessel proximal to the fistula, by repeated digital compression, has been recommended. The preliminary ligation of the proximal vein or both proximal and distal veins is advantageous and is sometimes warranted.

Two fatalities occurred in our series of arterial accidents and arteriovenous trauma; the first in an elderly patient who died of a pulmonary embolus after an embolectomy had been successfully performed on the first portion of his axillary artery, the second in an elderly patient who developed a rupture in a femoral artery with consequent large hematoma formation. In the latter case death ensued shortly after the ligation of the femoral artery proximal to the rupture.

What about the re-establishment of continuity of arteries by end-to-end anastomosis? It sounds good and looks all right in pictures, but the cases in which it could be even so much as attempted are few and far between. Those whom I regard as the best authorities on the subject of vascular surgery say, "Don't try it; it won't work."

Whether or not absorbable or non-absorbable ligatures are used seems to make not a great deal of difference. Only one of our patients hemorrhaged secondarily. This occurred after one week in a patient in whom early operative intervention was regarded as imperative (due to pain and steady increase in the size of the hematoma), despite the known existence of infection and much soft tissue damage and death. Following secondary ligation and leaving the wound open, the patient went on to an uneventful recovery and has a good leg.

CASE REPORTS

Case I. The patient, age twenty-one, was admitted October 11, 1942, with a lesion in the right popliteal area due to shell fragment wound. This had existed two months and was an arteriovenous fistula between the popliteal artery and vein. Principal symptoms and signs were: Expansile pulsation, thrill and bruit over the right popliteal area; irregular granulating wound of the right popliteal area. Motion of right knee was limited to 50 per cent of normal. Operation was performed on October 28th. Treatment: Excision of the arteriovenous fistula with quadruple ligation was carried out and the patient was cured.

Comments. This patient revealed readily demonstrable Branham's sign, but there was no demonstrable cardiac enlargement. The patient received paravertebral injections of his right lumbar sympathetics with striking results. Motion of right knee joint was gradually regained; however, full function was not completely restored until approximately eight months had elapsed. He was discharged from the hospital well.

Case II. The patient, age fifty-two, was admitted Feb. 21, 1943, with a lesion in the right axilla, received from a high pressure test line explosion one hour previously. He had suffered a severance of the right axillary and right circumflex arteries. The principal symptoms and signs were terrific hemorrhage from gaping wound of the right axilla. Operation was performed on Feb. 21, 1943, March 23rd, April 17th and May 13th. These consisted of (1) axillary circumflex and axillary artery ligated; (2) amputation above elbow;

(3) removal of metal fragment; (4) removal of metal fragment. The patient's life was saved; however, amputation of the right arm above the elbow as a result of dry gangrene was necessary.

Comments. Two factors may have contributed to the inevitable loss of this patient's arm: (1) severance of the axillary circumflex artery as well as the axillary artery may have fatally impaired the collateral circulation; (2) there was extensive and severe soft tissue damage about the right shoulder and axilla. This, aside from the vascular trauma, is distinctly conducive to failure of adequate circulation. In any event, it is believed that the chance of saving this arm would have been much better if the axillary vein had been ligated at the same time as the artery.

Case III. The patient, age twenty-one, admitted December 23, 1943, had a gunshot wound in the mid-section of the upper right arm. This had occurred three and one-half months before. It was an arteriovenous aneurysm of the brachial artery and vein.

Examination at time of admission revealed complete paralysis of his median and ulnar nerves on the right. There was a loss of both motor and sensory senses. There was a mild causalgic burning of his right palm and anesthesia in the area of the medial, anti-brachial cutaneous nerve on the right side. A pulsating tumor about the size of an English walnut was readily demonstrable in the mesial aspect near the mid-section of the right arm. A thrill and bruit characteristic of an arteriovenous aneurysm were readily elicited over this tumor. A positive Branham's sign was readily demonstrable. *X*-ray revealed no evidence of cardiac enlargement.

On March 4, 1944, an arteriovenous aneurysm was excised from his brachial vessels and quadruple ligation was done. Pains were taken to ligate the brachial artery just distal to the superior ulnar collateral proximally and just proximal to the inferior ulnar collateral distally. A neurolysis was done upon both median and ulnar nerves, both of which were densely involved in the scar tissue surrounding the aneurysm. The median nerve had been nicked to about its mid-diameter, the ulnar nerve was markedly narrowed. The continuity of both trunks, however, was still intact. (Fig. 1.) The patient was cured.

Comments. The wound healed by first intention and the circulation in the hand and arm improved almost immediately. However, causalgic pains persisted in the hand. This responded in a most gratifying manner to the injection of the cervical sympathetics with 1 per cent procaine. Normal sensation and function were slowly returning to this man's right hand and arm when he was returned to limited duty four months postoperatively.

Case IV. The patient, age twenty-one, was admitted December 23, 1943, with a gunshot wound of the right femoral area. This was of two months duration. It involved an arteriovenous aneurysm between the right femoral artery and vein. Principal symptoms and signs were marked pulsation over the right femoral and inguinal area; loud bruit and pronounced thrill were also present over this area. The patient complained of numbness and a tired feeling in his right leg.

On January 11, 1944, the abdomen was opened, right iliac artery and vein were exposed, and soft rubber slings were placed around these vessels as a safety precaution. Through a second incision below Poupart's ligament, the femoral artery and vein were exposed and on arteriovenous aneurysm was demonstrated just distal to the profunda branch of the femoral artery and the junction of the saphenous vein with the femoral vein. The segment containing this aneurysm was excised and quadruple ligation was done. The patient was cured.

Comments. Considerable bleeding was encountered from collaterals connected with the excised segment, despite the fact that the artery and vein were occluded with soft rubber slings proximal to the lesion. It was difficult in this case, as has been true of our entire series, to understand how bleeding is ever sufficiently controlled to permit definitive and detailed plastic repair of vessels at the site of an arteriovenous aneurysm. The circulation in this man's leg appeared to improve immediately following operation. He received 1 per

cent procaine injections of his right lumbar sympathetics daily for four days postoperatively. Postoperative convalescence was uneventful and two weeks following operation, the patient was up and around and experienced no symptoms other than moderate fatigability of his right leg. Chromic gut absorbable sutures were used throughout for ligation of large vessels in this case.

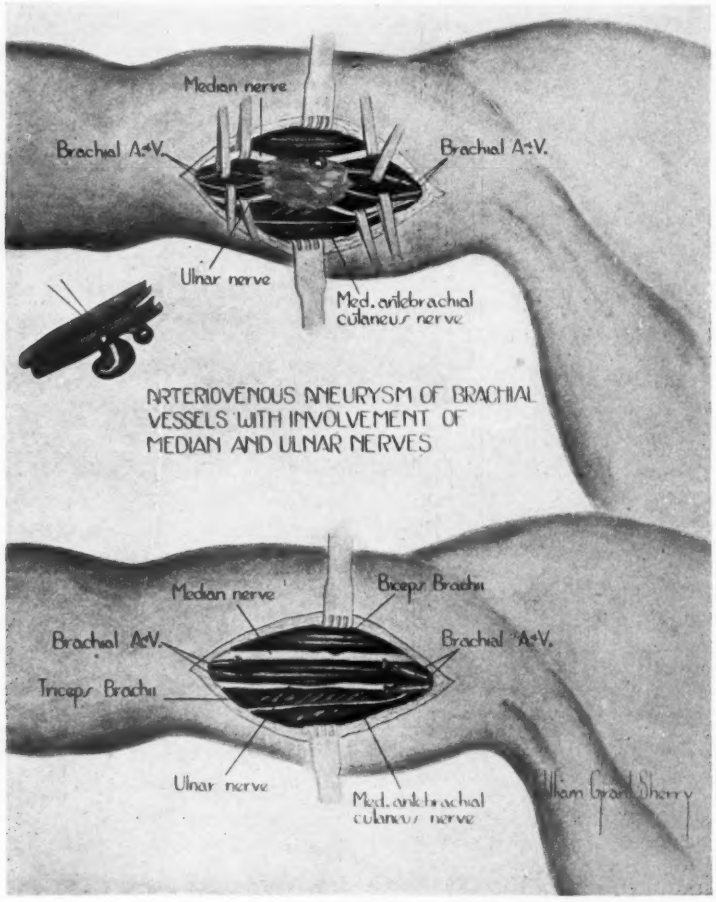


Fig. 1. Arteriovenous aneurysm of brachial vessels treated by quadruple ligation and excision. Note nick in median nerve and thinning of ulnar nerve.

Case V. This patient, age twenty-one, was admitted on December 23, 1943, with a gunshot wound of the left popliteal area. Its duration was two months. It consisted of an arteriovenous aneurysm between the popliteal artery and vein. The chief symptom was that of numbness in his left leg from the knee down, also tingling and a feeling of coldness in his foot. He was unable to straighten his knee entirely, and undue fatigability of his calf muscles was noticeable upon walking. There was a well defined palpable mass in his popliteal area which pulsated and produced a pronounced thrill. Auscultation revealed a loud bruit. Here was a classical picture of an arteriovenous aneurysm.

A quadruple ligation was done upon the popliteal vessels and the aneurysm was excised on January 18, 1944. A false aneurysmal sac the size of an English walnut was present. The usual surprising degree of bleeding from collaterals attached to the sac accompanied this operation despite the fact that the artery and vein were ligated both proximally and distally before excision of the aneurysm was attempted. The patient was cured.

Comments. The immediate improvement which followed this operative intervention was most gratifying. Twenty-day No. 2 chromic catgut was used for ligatures

on large vessels. This patient returned to duty symptom free.

Case VI. The patient, age twenty, was admitted December 23, 1943, with a gunshot wound of the right axilla received, two months previously. It consisted of an arterial aneurysm of the right axillary artery.

At the time of admission there was a small, well healed bullet wound of entry in the anterior axillary fold and a somewhat larger but likewise well healed wound of exit in the posterior axillary fold. A pulsating tumor about the size of a hen's egg was readily demonstrable in his right axilla, however, no thrill was perceptible nor could a bruit be heard. It was, therefore, considered likely that this was a simple false aneurysm, due to an interruption of continuity of the wall of the axillary artery and that a true arteriovenous fistula did not exist. At operation the right subclavian artery was ligated and divided at the triangle of election.

The patient experienced immediate relief from the annoyance of the pulsation in his right axilla following operation and he thought he had more feeling in his hand and arm. How much of this was psychic is, of course, conjectural.

Comments. Neurological examination revealed lower brachial plexus paralysis (biceps, triceps, flexors and extensors of his arm, and all the hand muscles). The paralysis was worse distally, with complete wrist drop and total paralysis of all the finger movements. The median nerve function in the hand was more affected than the ulnar. Only slight atrophy of forearm muscles was present. There was sensory loss only in median nerve distribution. The hand and finger nails were dry and scaly. It was considered conceivable that this man's paralysis might be in part or wholly due to pressure of the aneurysm upon the nerve trunks in the axilla. However, the paralysis of this patient's arm and hand failed to improve appreciably following ligation of the aneurysm, although there was no further evidence of disturbance of circulation in this extremity and no evidence of recurrence of pulsation in the axilla. The aneurysm, therefore, is considered to have been cured.

As a means of correcting this patient's wrist drop the flexor carpi radialis and the flexor carpi ulnaris were transferred from the volar to the dorsal aspect of the wrist. The flexor carpi radialis was hooked onto the long and short extensor and abductor muscles of the thumb, and the flexor carpi ulnaris was hooked on to the common extensors of the fingers. A good functional result was obtained. This patient was surveyed to limited duty.

Case VII. This patient, age nineteen, was admitted December 23, 1943, with a gunshot wound in the right subclavian region, of two months' duration. It was an arteriovenous aneurysm. Principal symptoms and signs were numbness and weakness of the entire right arm and hand; hyperesthesia and hyperalgesia present over the median nerve distribution. A pulsating aneurysm was plainly visible and palpable; a loud bruit and marked thrill were present in the right subclavian region mesial to the axilla.

Treatment consisted of (1) right subclavian artery ligated; (2) quadruple ligation, axillary vessels—arteriovenous aneurysm of the first portion of the axillary vessels excised. The patient was cured.

Comments. The right subclavian artery was ligated preliminarily through the triangle of election. The artery was divided between ligatures and nothing further in the way of surgery was done. Further surgery was contemplated, depending upon whether the circulation in the arm was improved or further impaired by this ligation. It was thought that this aneurysm might well be a traumatic arterial aneurysm rather than an arteriovenous fistula, and that simple ligation of the artery might suffice. The state of the circulation in his hand did not appear to be appreciably affected one way or the other. Certainly it was not made worse. The bruit, thrill and pulsation disappeared and remained absent for about a week, when a slight thrill again became perceptible to the palpating hand. The subjective symp-

toms of pain, numbness and cold feeling largely disappeared from the patient's arm and hand, temporarily. However, after about a week the whole symptom complex had become re-established.

On February 10, 1944, under general anesthesia, a well defined arteriovenous aneurysm of the first portion of the axillary vessels was exposed through a transverse incision just below the clavicle. The involved segment was excised and a quadruple ligation was done. A sac about the size of the distal phalanx of a man's thumb was found extending inward and was densely adherent to the posterior cord of the brachial plexus and to the lateral and middle cords. The patient's convalescence from this operation was uneventful, the subjective symptoms disappeared entirely from his arm and but for some inordinate fatigability, function of his arm had been completely restored within a month. He was discharged to duty well.

Case VIII. This patient, age nineteen, was admitted December 23, 1943, with a gunshot wound of the left popliteal area of three and one-half months' duration. It consisted of an arteriovenous aneurysm of the popliteal vessels.

The patient sustained a fractured left femur as a result of machine gunfire. His left leg was encased in a plaster of paris cast with hip spica which he was wearing at time of admission to this hospital. Upon removal of this cast, a pulsating, tumor-like mass the size of a lemon was readily apparent in the popliteal space. A characteristic thrill and bruit were unmistakably demonstrable. There was some dilatation of the superficial veins with marbling in the region of the knee. Pressure over the vessels of the leg proximal to the popliteal space produced a slowing of the pulse—a typical Branham's sign. Chief subjective symptoms were a numbness and a tingling sensation in the left foot and leg.

Quadruple ligation and excision of popliteal aneurysm were performed on March 4, 1944. The popliteal nerve was densely bound to the aneurysmal sac by fibrous adhesions. This nerve was carefully preserved intact. The patient was cured.

Comments. The subjective symptoms promptly subsided following operation. Paravertebral injection of the left lumbar sympathetics with 1 per cent procaine solution was done daily for the first four postoperative days. The foot promptly assumed its normal color. This patient's convalescence was uneventful except for the fact that preternatural mobility at the site of the fracture of his femur increased, indicating a separation of the partially healed fragments. His leg was replaced in a cast and treatment of his fracture was resumed.

Case IX. The patient, age twenty-five, admitted April 1, 1944, suffered a knife wound in the posterior aspect of the leg, a short distance below the popliteal space. This man is alleged to have fallen accidentally and plunged a boning knife through the upper extremity of the calf of his leg one hour before admission. There was a complete severance of the popliteal artery. The principal symptoms and signs were cyanosis, coldness, and pain in the left foot and leg.

Treatment consisted of ligation of the bleeding vessels. Paravertebral 1 per cent procaine injections of his left lumbar sympathetics were begun the day of admission and were continued daily for one week. Intermittent use of a Pavex vacuum boot was begun on the day following admission and was continued for a period of ten days. Despite these measures, plus a number of transfusions, his left foot remained cold and livid, then began to assume the classic appearance associated with gangrenous changes. A severe infection developed in his leg which required incision and drainage. A markedly elevated temperature was definitely modified by the use of penicillin, however, the necessity for amputation became obvious. A guillotine type amputation was, therefore, done at the site of election, approximately six inches below the tibial tubercle. His convalescence following amputation was uneventful. The patient was cured but with loss of a leg.

Comments. It is a well recognized fact that sudden interruption of continuity and ligation of the large vessels of an extremity is more conducive to gangrenous changes than the ligation of similar vessels for an arteriovenous fistula. However, in this case it was never known whether the popliteal vein was actually severed and ligated. It is considered likely that this was not the

case and that the chance of saving this leg would have been much better if the popliteal vein had been ligated concurrently with the popliteal artery. The supervention of a severe infection in the wound, moreover, contributed in an inestimable measure to the fatal impairment of circulation in this patient's leg.

Case x. This patient, age nineteen, was admitted to the hospital April 20, 1944, with a lesion of the right wrist. This wrist had been pierced by a piece of sharp wire one year previously, and the patient suffered with an aneurysm of the radial artery.

About one month after sustaining a puncture wound of his wrist by a piece of wire, the patient noticed a small, pulsating mass over the radial artery. This gradually became larger for a few months and has been stationary for the past four to five months. Aside from a tight, uncomfortable feeling in his wrist and the awareness of a pulsation, the patient experienced no subjective symptoms. Examination revealed a well defined pulsating tumor, the size of an English walnut, on the volar aspect directly over the radial artery.

Aneurysmorrhaphy was carried out on May 13, 1944. The radial artery was exposed and a fusiform aneurysmal sac, the size of a small English walnut, was demonstrated. This sac was opened, redundant tissue was excised, and the continuity of the artery was preserved by reconstructive surgery. Atraumatic fine chromic gut was used as suture material. The aneurysm was cured.

Comments. A weak radial pulse was palpable at the site of the aneurysm at the time of the patient's discharge from the hospital one month following operation.

Case xi. This patient, age eighteen, was admitted to the hospital August 17, 1944, with a congenital lesion of the right vertebral artery and vein. This had been present ever since patient could remember. There existed an arteriovenous fistula between the right vertebral artery and vein.

Principal symptoms and signs were pulsation, thrill and bruit, in the right occipital region. This patient has experienced tinnitus in the right ear, and a buzzing sensation in his head along with occipital headache for a period of years.

Treatment on August 29th consisted of excision of the segment containing the arteriovenous fistula, with quadruple ligation of vessels. The patient was cured and symptoms of headache, tinnitus, and buzzing were all relieved by operation.

Comment. An incision four inches in length was made diagonally in the left occipital region and by dividing part of the fibers of the sternocleidomastoid, the trapezius, and the splenius cervicis muscles, the triangular area bounded by the obliquus capitis inferior, the obliquus capitis superior and the rectus capitis posterior major muscles, the aneurysm was exposed. By careful dissection this aneurysm was demonstrated to involve the vertebral artery and its accompanying vein. The segment containing the aneurysm was excised and the vessels ligated proximally and distally. This lesion involved that portion of the vertebral artery which lies against the base of the skull immediately before it enters the foramen magnum.

Case xii. The patient, age twenty, was admitted on August 4, 1944, with a gunshot wound of the femoral vessels. (Figures 2a and 2b.) This wound was received two and one-half years previously. An arteriovenous fistula between the femoral artery and vein existed.

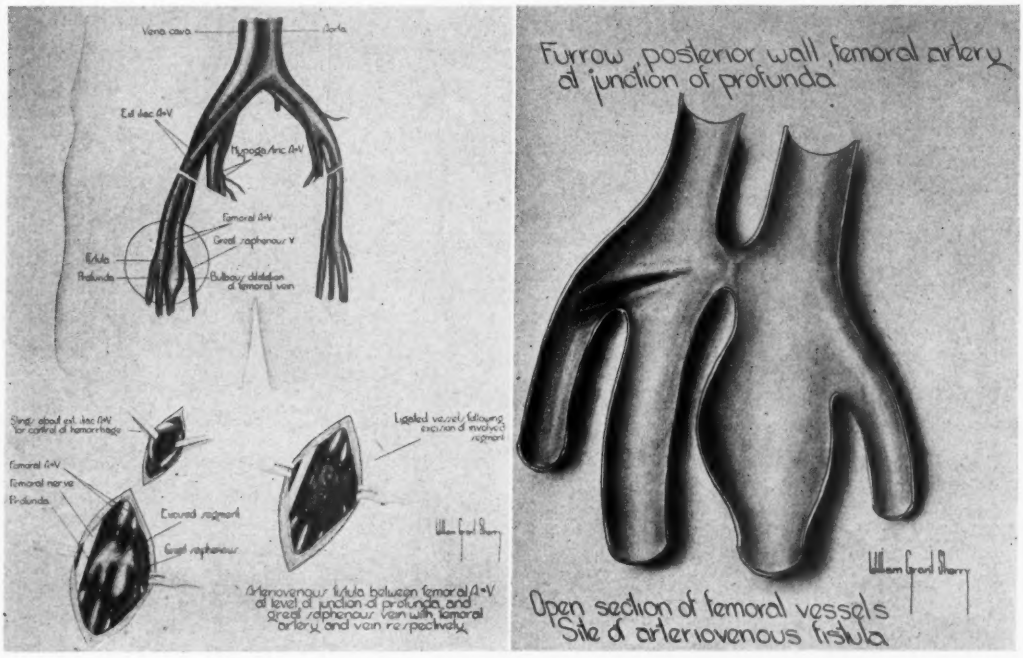
Principal symptoms and signs were pulsation, thrill and bruit in the right groin; marked fatigability of the right leg; intermittent claudication; scar marking point of entry of a rifle bullet over anteromesial aspect of the right thigh, 1 inch below Poupart's ligament.

Treatment consisted of (1) excision of the arteriovenous fistula, with quadruple ligation of the femoral vessels, also ligation of profunda artery and saphenous vein; (2) exploratory incision, right popliteal space, and aspiration of the right popliteal artery; (3) amputation of the right leg.

Impending gangrene became manifest during the first twenty-four hours following excision of the arteriovenous fistula and ligation of vessels. Despite every effort to forestall this calamity, including daily paravertebral injection of the lumbar sympathetics, the use of alcohol systematically, the use of spinal anesthesia and Pavex boot, a line of demarca-

tion became established in the neighborhood of the knee joint and the lower leg became frankly gangrenous, making amputation imperative.

extenuating circumstances we have the following to offer: A year subsequent to the gunshot wound in the right femoral region


Vena cava
Aorta
Ext iliac A-V
Hypogastric A-V
Femoral A-V
Great saphenous V
Profunda
Bulbous dilatation of femoral vein
Femoral A-V
Femoral nerve
Profunda
Excised segment
Great saphenous
Ligated vessel following excision of involved segment
Arteriovenous fistula between femoral A-V at level of junction of profunda and great saphenous vein with femoral artery and vein respectively
Furrow, posterior wall, femoral artery at junction of profunda
Open section of femoral vessels
Site of arteriovenous fistula

A B

FIG. 2. A, arteriovenous fistula, femoral vessels. This fistula, the result of a gunshot wound, had become established at the level of the junction of the profunda artery and great saphenous vein with the femoral artery and vein, respectively. It was impossible owing to the location and peculiar arrangement (see Fig. 2B) of this fistula, to preserve continuity of either the profunda artery or the saphenous vein. All of the great vessels immediately adjacent to the fistula were ligated and the intervening segment excised. This patient promptly developed gangrene of his lower extremity which ultimately required amputation above the knee. B, this drawing illustrates the damage to the profunda artery which made it impossible to maintain continuity of this vessel. When the femoral vessels were free from their bed there was profuse bleeding from the profunda artery through the break in its wall, as illustrated.

Comment. The result in this case was dramatically tragic and while there were certain known circumstances which were regarded as unfavorable, the operation in itself was no more radical than had been done on two other patients of our series. In this case the arteriovenous fistula communicated with the femoral artery and vein at a site exactly opposite the junction of the profunda with the femoral artery and slightly below the junction of the saphenous with the femoral vein. An effort was made to preserve the profunda artery and saphenous vein but the location of the fistula was such as to make this accomplishment impossible, therefore, the involved segment was excised and the standard quadruple ligation was done. As

and one and a half years prior to the operative intervention instituted here, the patient sustained a considerable wound of his right thigh due to coming in contact with a buzz saw. This may well have interfered with certain important collaterals. Moreover, on two different occasions following the gunshot wound of the thigh, this boy had received gunshot wounds of his leg below the knee from a .22 caliber rifle. One of these wounds may have damaged the anterior tibial, the other one the posterior tibial artery. These several circumstances are believed to have together constituted a very real contributing factor to the inadequate circulation which prevailed in this leg following the ligation of the main vessels. There was in any event

one observation which should have received more consideration. That was the fact that no positive Branham's sign could be demonstrated on this patient preoperatively. This indicated that the fistula was small and because the fistula was small, the period of its duration notwithstanding, it was insufficient to produce the abundant collateral circulation usually associated with an arteriovenous fistula.

Case xiii. This patient, age twenty-nine, was admitted to the hospital on September 29, 1944, with a gunshot wound of the left axillary artery (Fig. 3), sustained one hour previously. He suffered a severance of the axillary artery immediately below the clavicle by a .45 caliber bullet.

Principal symptoms and signs were profuse arterial bleeding from the wound of entry below the clavicle; loss of function and sensation in the left forearm and hand; a large hematoma beneath pectoralis major muscle and shock.

Ligation of the subclavian artery in its third portion was carried out. Hemorrhage was arrested. Circulation in the arm was preserved through the anastomosis of the branches of the thoracocromial trunk immediately below the point of severance and the thyroid-cervical trunk above the level of ligation. Function of the arm remains impaired due to damage of the brachial plexus.

Comment. This patient was brought to the hospital in a markedly exsanguinated condition one hour following receipt of a gunshot wound from a .45 caliber pistol which severed his left axillary artery. The bullet entered the left shoulder at the junction of the middle and outer third of the clavicle at a point immediately below the clavicle and immediately over the axillary artery. It passed inward, backward and downward and emerged through the triceps muscle on the posterior aspect of the arm approximately at the level of the upper and middle thirds of the humerus. There was no fracture of any of the skeletal structures about the shoulder. This patient's life was undoubtedly saved by the prompt action of a hospital corpsman who stuck his finger into the wound of entry and held it against the bleeding artery until the patient arrived at the hospital. The subclavian artery was ligated through the triangle of election and immediately following, the hand was completely cyanotic and cold. However, within twelve hours the circulation had apparently been restored in a very satisfactory measure. The hand was still of a dusky color but was warm and was not painful. The ultimate result in this case, insofar as the restoration of function of the patient's arm is concerned, rests largely upon the degree of damage that has been done to the brachial plexus, and how nearly completely the neurological surgeons will be able to repair that damage.

Fig. 3. Picture showing wound of entry and exit, 45 caliber bullet, also scar, supraclavicular region, marking site of incision for ligation of the left subclavian artery. The circulation in this arm was adequate. However, the damage done to the brachial plexus resulted in complete paralysis below the elbow.

SUMMARY

1. The pathogenesis, symptoms and signs of arteriovenous aneurysms have been reviewed.

2. Certain systemic phenomena have been given pointed consideration with especial attention to their cause.

3. The management of arteriovenous aneurysms has been discussed with reference to certain general principles as well as to the definitive treatment. In our experience quadruple ligation and excision has been employed routinely with entirely satisfactory results in all save one case (Case XII). Sympathetic nerve block was used practically routinely in our series and its value as a means of improving and maintaining the circulation in the affected extremity is unquestionable.

4. Some reference has been made to vascular trauma *per se*, that is, independent of arteriovenous fistula. Our experience indicates that when a large artery is ligated, a concomitant ligation of the accompanying vein is a distinct safeguard against subsequent gangrene.

5. Three patients in our series of thirty cases of arterial or arteriovenous trauma lost a limb due to gangrene. There were definite extenuating circumstances in each instance. Their cases are reported.

6. Several additional representative cases are reported, with illustrations of operative procedure.

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PAINFUL SCAR AND OTHER SURGICAL NEUROSES

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NEUROSIS deserves consideration as a surgical disease. Although it is not ordinarily amenable to operative therapy, no surgeon can be successful unless he is able to cope with it. The word neurosis has been abused by a multiplicity of definitions and has fallen into disuse although the adjective neurotic is heard frequently and with fairly definite meaning. For the purpose of this discussion neurosis can be considered as the willing acceptance of disability. Usually the disability is willingly accepted by the neurotic patient because it is a useful excuse for failure. There is an old saying that the biggest fool is the fool who fools himself. By this standard the neurotic is a fool and essentially dishonest. In self-pity he refuses to accept responsibility for his failure since that would necessitate admitting he was an incompetent weakling who needed to mend his ways. Instead he excuses himself by sickness than which there are few better excuses for failure. The excuse is substituted for the satisfaction of successful accomplishment and is always an easier solution of difficulty. The neurotic offers the excuse to himself so that he may continue to think well of himself. Whatever other instincts and desires may influence his conduct, one of the most important is the necessity of thinking well of himself. If his standards and ideals agree with ours, we admire him, too, and he likes that but our regard is distinctly of secondary importance.

Neurotic patients exhibit varying degrees of awareness of their subterfuge. At one extreme is the malingerer who plans his artificial disability with malice aforethought. Nearby is the compensation neurotic who will not allow himself to contemplate recovery until the case is settled. It is significant that it is the finality of the settlement and not its favorableness which has the curative effect. In the middle ground is the vast majority of neurotics who have only vague conscious appreciation of their fraud. At the other extreme is the neurotic who more or less honestly fears the effect of activity on his health. A good example of this extreme is the patient with completely quiescent pulmonary tuberculosis. In fact, such "honest" neurotics may not be really neurotic at all, for although they have accepted their disability at their physician's insistence they may have accepted it unwillingly.

The reasons for the neurotic's willing acceptance of disability are infinite. There are as many useful excuses for failure as there are ways of failing. Every child attempts at least once to use sickness as an excuse from school attendance. A weak heart may relieve a wife from boresome duties. The soldier may seek to escape the hazards of conflict or the rigors of training. No accomplishment in any field of human endeavor is too great or too small to be the object of ambition and to require an excuse for the failure to attain it. Minor failures incite mild neuroses which are exceedingly common and often do not of themselves have much influence on the life of the patient. The poor mental hygiene of such an ineffective attitude in any personal religion or philosophy of life is always of serious import, however.

To himself and to his boss, his friends and relatives it suffices simply for the neurotic to say "I am sick." The situation becomes more complicated when the doctor enters and the neurotic is called upon to explain and justify his disability. Like a thief explaining his loot he sometimes

has difficulty in doing so. The intellectual fumbling and vagueness of the neurotic describing his symptoms are often recognizable as characteristic, especially if the doctor demands details. The symptoms are usually of three types; exaggeration of the distress of normal sensations, exaggeration of mild organic disease, and persistence beyond the natural duration of past organic disease. The essential characteristic is the exaggeration of the severity and the disability. There is always a factual basis of some sort for the symptoms and this must be known before the degree of the exaggeration can be recognized.

The emotional disturbance which may be associated with neurosis frequently interferes with the normal function of the body through the rage-fear mechanism (Cannon).[1] The digestive and circulatory systems are especially susceptible to functional illness although no organ is immune.[2] It is sometimes difficult to distinguish symptoms of functional disorders from neurotic exaggerations of normal sensations. Functional illness may also arise from other types of emotional disturbance quite unrelated to neurosis. Severe functional illness usually arises from more profound mental disturbance than neurosis, such as a psychoneurosis or the irreversible degeneration of a psychosis. A neurosis is commonly successful and therefore not associated with severe mental conflicts.

The following subjective symptoms of functional disorders are often characteristic of neurosis: headache which is dull, generalized and constant rather than sharp, localized and periodic; vertigo which is really a giddiness; deafness when embarrassed; inconstant fatigue diplopia; foul taste in the mouth; globus dysphagia; morning nausea; insomnia not due to pain; morning fatigue; excessive occupational fatigue ("writer's cramp"); fluttering palpitation; sighing dyspnea; precordial pain of long standing not precipitated by exercise; gas distress not relieved by belching or passing flatus; immediate postprandial abdominal distress; any abdominal pain surviving two abdominal operations; pelvic pain not aggravated by catamenia; dyspareunia; chronic boredom; "jitteriness"; flitting, fleeting aches and pains not rheumatic; symptoms which "get his goat"; symptoms which make the patient nervous; symptoms than which the patient could stand any other kind easier; and finally, any ache or pain or symptoms not ordinarily disabling except for the obvious exaggeration.[3]

More objective evidence of functional disease which may be neurotic in origin are: migraine which suddenly becomes much worse; chronically coated tongue; extrasystoles; paroxysmal tachycardia; fainting; habitual non-productive cough; morning vomiting; low grade fever, never over 100°F.; anorexia nervosa; diarrhea with mucus but without blood; amenorrhea; pruritis ani and vulvae; hyperpnoeic tetany; enuresis; the polyuria and diarrhea of excitement; nail biting; stuttering; spasmodic torticollis; and other nervous habits and ties. Some of these are as characteristic of functional disorder as the whoop is of whooping cough.

The functional illness of nervous indigestion is particularly important to the surgeon contemplating an operation for gallstones or peptic ulcer (Alvarez).[4] A recent cholecystectomy for cholelithiasis failed because the patient continued to complain of a nervous indigestion. Detailed review of the symptoms prior to the operation revealed that the symptoms even then were entirely functional and that the gallstones were in fact silent.

A very common and typical neurosis is the painful scar. Any painful wound healing with a scar creates an ideal situation for the development of neurosis. Many a rugged individualist has discovered the luxury of sympathy and freedom from the demands of ambition during the confinement of an operation or serious injury. The fact of the wound and the visible scar are good presumptive evidence of disability. It is easy to claim

persistence of the severe distress of the healing wound and to exaggerate the normal mild discomfort of the scar. This is especially true, as is too often the case, if the doctor consulted is confused as to the exact limit of possible disability from a healthy scar. Distress in a scar is on the basis of the amputation neuroma phenomenon. Any incision cuts some nerve filaments, the proximal ends of which develop small amputation neuromas. These are hyperesthetic for weeks and in some instances the scar never ceases to be sensitive. We have never seen this sensitiveness disable a healthy minded patient. If a large nerve is cut, a really painful amputation neuroma may develop which requires surgical relief. Such a real amputation neuroma is easily distinguished from a neurotic's exaggeration, however, because it is one of the most sharply localized lesions in pathology. Postoperative hernias and scar contractions are easily recognized, too. Peritoneal adhesions may cause intestinal obstruction but never a painful scar.

Disability following head injury is one of the most difficult situations to evaluate but neurosis is more common than disability from organic changes. Physical injury to the brain without objective evidence and yet severe enough to be disabling must be rare. The episode of the accident and the period of unconsciousness constitute severe psychological trauma following which degeneration of the patient's character is understandable. The complaints are usually those of headache, tinnitus, vertigo, loss of memory, irritability and "nervousness." The organic headache should be sharp, severe, periodic, localized, and disabling but relieved by recumbency like the post-lumbar puncture headache whereas the neurotic's headache is usually constant, dull, generalized and rarely confines the patient indoors. Disabling headache which persists for months after head injury deserves trephine exploration for subdural hematoma anyway. The tinnitus, if disabling, should be associated with demonstrable and usually unilateral deafness. The vertigo, if disabling, should occasionally cause injurious falls and be associated with nystagmus. The nystagmus may be apparent only after motion such as sudden recumbency or standing upright. Loss of memory is hard to measure but should be associated with impairment of the intellect demonstrable by simple tests such as adding a column of figures or reading a newspaper. The absence of a pre-injury standard for comparison reduces the value of such tests; although if a man who got good marks in school has difficulty in reading and understanding a newspaper, it is easy to believe his memory is impaired. Significant changes in temperament are usually apparent to the patient's relatives.

Too often the neurosis following head injury is unwittingly initiated and encouraged by the doctor in charge of the patient during the convalescence. There is little evidence that prolonged bed rest and inactivity following head injury minimize the organic changes. On the contrary extreme solicitude for a patient who may feel quite active undermines his self-confidence and leads him to expect mysterious unhappy eventualities. Even if convulsions can occur years after head injury it is not wise for the patient to stand around feeling sorry for himself awaiting and expecting them. Head injury cases especially need encouragement and urging to overcome their difficulties. Even in the presence of organic impairment the disability is often neurotic. The detection of this neurosis resolves into a fine point of clinical judgment but is entirely possible and may be done with positive certainty in many instances.

Neurosis often explains the failure of patients to accept surgical relief for hernias and other defects. The refusal is rationalized on the basis of fear of the operation or financial difficulties but in fact the patient is a contented failure with a good alibi. He is often careful to avoid bringing the matter up and may even refuse to

discuss it when he goes to the doctor for some other condition. If the hernia or defect becomes really painful or actually disabling, surgical relief is usually promptly obtained.

Stealing identifies the thief and neurotic exaggerations establish the diagnosis of neurosis. It is emphasized that the diagnosis of neurosis is not simply a matter of excluding organic disease. Rather it is a matter of establishing the full extent of the organic basis so the fact of the exaggeration can be identified and measured. The existence of neurosis must not be allowed to obscure the presence of organic disease. It is very embarrassing to have a hopeless neurotic suddenly die of a disease the symptoms of which had been dismissed as unimportant. Similarly the presence of neurotic features should not preclude the recognition of more serious mental disorders like psychoneurosis and psychosis. It is unnecessary to know the reason for the neurosis or the uses to which it is being put. A social service worker's report on a thief's environment and a psychoanalysis of the neurotic's sub-conscious mind may be interesting and helpful but they are not essential to the diagnosis.[5]

Neurosis is a disease of civilization; where else in nature is disability beneficial? The neurotic is apt to have a family background of emotionally unstable relatives. Many neurotics have been cursed in childhood by indulgent parents who rewarded failure instead of allowing the education of natural consequence to follow unsuccessful efforts. In the army neurosis has been described as contagious from its spread through a group of soldiers like an epidemic. It is practically universal, being no respecter of age, sex, color, or social standing. Doctors commonly learn from their personal experiences with it. Usually the neurotic is constitutionally inadequate and of low intelligence. People in the lower social strata have more failures to excuse and neurosis is more common among them, although they may not as frequently come to the attention of the doctor. The excessively ambitious who may be actually quite successful in life but whose failures are relative may also resort to neurosis. Certain racial groups seem to be particularly prone to adopt the neurosis mechanism. Neurotics commonly tend to acute exacerbations of chronic deficiencies of the ordinary virtues. They are not particularly happy in their deceit any more than a thief always enjoys his ill-gotten gains, but a successful neurotic is always happier than an unsuccessful one. During economic depressions and after defeat in war whole nations may become neurotic in their refusal to accept responsibility for their misfortunes and blame all their troubles on certain real or fancied social evils.

The therapy of neurosis may be beyond the scope of the surgeon. However, by virtue of his diagnostic investigation, his knowledge of the natural limits of organic disease and his possession of the patient's confidence he may be in an uniquely effective position unattainable by a psychiatrist. Sometimes the surgeon is unable to avoid assumption of responsibility toward neurosis as in the instance of painful scars. It is impossible for the surgeon to be neutral not only because he created the scar but because any evasion or compromise has the effect of fixing the neurosis and dignifying it into the respectability of actual disability. Unless the surgeon actively denies the disability he becomes an accessory to the fraud.

Spontaneous recovery from a neurosis may occur when revisions in the patient's life and environment remove the need for it, just as sudden riches may reform a thief. A temporary remission occurs frequently during severe intercurrent illness the disability of which displaces the disability of the neurosis. Neurotics usually cooperate as good patients immediately postoperatively and put up a good fight against serious illness, but the neurosis commonly recurs when the organic disease subsides. Sometimes the neurotic is caught with his neurosis and although the dis-

ability is no longer needed or welcome, a cure of some sort is necessary to save face. Under these circumstances almost any socially acceptable cure will be effective and the more dramatic the better. Hypnosis, psychoanalysis, a visit to a holy shrine or a famous distant clinic will be satisfactory. Sometimes an ill advised or irrelevant operation will be accepted and be mysteriously successful. A cure from a chiropractor may be very nice, too. By accepting a cure from the chiropractor the neurotic can also give the lie to that mean doctor who told him (1) there was nothing the matter with him, and (2) that the chiropractor was (also) a fraud. Neurotics prefer to patronize the cults who do not embarrass by bothering to make a diagnosis and thus many neuroses never come to the attention of a doctor. Some are discovered accidentally during a consideration of some organic disease or the neurotic may come seeking relief from the excessive discomfort of functional disturbances. Confirmation of the disability and not relief or cure may be the real reason for the visit to the doctor, especially if the neurosis is being successful. Cure of these neuroses is very difficult just as it is difficult to reform a successful thief.

To the extent to which the disability represents an honest fear of the deleterious effect of activity on the patient's health ("honest neurosis") convincing reassurance will produce a cure. These patients have to be thoroughly convinced and it is often difficult to distinguish between the honest fear of disease, the fear of losing the disability and the more serious states of generalized fear associated with psychoneurosis.

Occasionally, confused individuals will respond remarkably to a clarification of their situation by a frank explanation just as a thief may reform after near-discovery or after a good non-specific religious revival sermon. Some neurotics think of their "nervousness" as a symptom of a diseased mind over which they have no more control than over the fever of pneumonia. When the doctor explains their problem as one of character and not one of health, they may rise to the occasion with will power and courage. The more intelligent and otherwise honorable the patient is, the more probable is a favorable response to a frank discussion. We have compared the neurotic to the thief because we believe the analogy is reasonable and instructive. However, thieves do not bring their vices to the doctor for justification or therapy.

Neurotic patients are often seriously disabled and therefore justify the expenditure of considerable time and effort by the surgeon. Whether successful in therapy or only in antagonizing the patient the conscientious surgeon has the satisfaction of having made an honest attempt and of refusing to be a party to the neurosis. Surgeons tend to avoid the embarrassment of discussing neuroses with their patients although they do not allow the greater embarrassments of operation mortality or morbidity to deny the patient the benefits of their services. Such embarrassment can be avoided in large part by skillfully maintaining an impersonal attitude during the discussion. Any reformer's zeal or display of personal disapproval by the doctor impairs the effectiveness of his efforts anyway. The discussion of the neurosis with the patient should start with a consideration of the factual basis for the symptoms. It is absurd and harmful to dismiss these patients with the simple: "There is nothing the matter with you," or ever to allow the patient to think that his doctor considers the symptoms imaginary. Any effective therapy for any existing organic disease should be insisted upon whether directly relevant to the neurosis disability or not. If the symptoms arise from severe functional illness, a somewhat lengthy education of the patient is required and the assistance of a psychiatrist may be necessary. The concept of functional disease is quite foreign to most patients although fainting and the

polyuria of excitement are useful examples familiar to all. The element of exaggeration of the disability should be discussed on the assumption that it is a manifestation of honest fear of activity. Then should follow definite advice as to the gradual resumption of activity even if it hurts. The disability should be regarded as a handicap to be overcome rather than an insurmountable obstacle; it just must not be allowed to interfere with anything the patient wants to do or ought to do. Reassurance should be very definite that activity will be beneficial and not harmful. The neurotic with a painful scar for instance should be assured that the wound is healthy and that the distress is normal. The scar itself may be firmly massaged by the patient and stretched by body bending exercises if it seems advisable to treat it at all. After every injury there is a last residual soreness of the involved region which has to be worked out by exercise. The symptomatology of disuse has not been thoroughly studied but a perfectly healthy limb kept in a cast is uncomfortable and goes through a distressing readjustment upon return to activity.

So far in the discussion the patient has been given the benefit of every doubt and there has been no embarrassment. If the discussion of the emotional disturbance at the base of the functional illness proves difficult, it may be left for the more skilled management of a psychiatrist. The neurotic reaction of enjoying and benefiting by poor health, etc., can be presented impersonally as an universal human frailty and an element which only the patient himself can say how much it applies to his own present situation. The neurotic will rarely say anything except to deny it even if the discussion is carefully phrased to avoid any accusation. Legal minds regard denial before accusation as evidence of guilt and it usually works out that the more emphatic the denial the more surely correct is the diagnosis of neurosis. If after all discussion the patient insists he still hurts, there is no better reply than the one "What can't be cured must be endured," but the doctor must be prepared to convince the patient that no specific cure is anywhere available.

The prevalent pessimism regarding the therapy of neuroses arises from the difficulty of influencing neurotics with unskilled efforts, the difficulty of influencing successful neurotics, and the extreme difficulty of influencing any neurotic unless the proper rapport exists between patient and doctor. Effective rapport can only exist when the patient feels his need for advice, i.e., comes voluntarily seeking aid, when the patient has so much confidence in his doctor that he selects him from his competitors, when the patient realizes the doctor is working solely for him and has his welfare alone at heart, and finally when the patient so appreciates the doctor's services that he pays his fee. Advice is usually taken as worth what it costs so it is part of the treatment to insist on the fee being paid.

Absence of rapport is the fundamental defect in any system of socialized medicine. The armed services are currently illustrating the difficulties of socialized medicine in dealing with neurotics. The situation is aggravated by the fact that nearly every soldier is in a position to benefit by disability. Sometimes the most crude efforts at neurotic deception lead to the recognition of the soldier as an undesirable and so he is "rewarded" with a disability discharge and a return home where he can get a lucrative defense job. His instinct of self preservation justifies howsoever otherwise dishonorable efforts to avoid the hazards of combat. If he waits until actual combat before quitting, he is rewarded with a hero's status ("shell-shocked") and often treated with more considerate sympathy than if he had lost a leg. His doctor is handicapped by being accidentally designated and not selected. The medical officer may have been a trusted family physician to a large practice before entering the service but

the neurotic soldier sees him primarily as an officer and, therefore, as a boss, working for the government under the pressure of directives from Washington. That there are not more neurotic quitters under combat is high tribute to the intelligent idealism of our champions of democracy. That the management of neurotic soldiers is as successful as it is, is even higher praise for the doctors of the Medical Corps. Perhaps the medical officers' handicaps are in part compensated by the more bluntly frank methods which have been adopted by most doctors in the Army.

In general it may be said that the medical profession can not point with too much pride at our record in handling neurotic patients. The pessimistic attitude of most doctors toward neurotics is proof of our failure. Doctors express in private their contempt of neurotics and joke rather ruefully at the time and effort wasted on them. Too often, however, the neurotic is actually treated with what amounts to encouraging sympathy by being given placebo prescriptions, "shots," and physiotherapy. The doctor is too kindly (and cautious) to risk offending his patient. One of the most evil aspects of neurosis is its effect upon the patient's family and society. The presence of a neurotic makes any family a sick family and impairs its efficiency in society. The doctor's responsibility extends beyond the patient to the family and society. Nothing less than a bold facing of the problem and a frank discussion discharges this responsibility. Sympathy or any act either of commission or omission which has the effect of encouraging and fixing the neurosis is to be lamented. Even if the patient may not appreciate learning the true nature of his condition, a family which understands the situation is better able to defend itself from the impositions of a neurotic member. Excessive concern with the individual at the expense of society is the basis for the accusation that we doctors all belong to the "sob-sister" school of psychiatry.

CONCLUSIONS

1. Neurosis is the willing acceptance of disability usually as an excuse for failure.
2. Neurotic patients are more or less conscious of the deception.
3. The exaggeration of disability and certain symptoms are recognizable as characteristically neurotic.
4. The organic basis for the symptom must be known in order to establish the extent of the exaggeration.
5. Surgeons cannot refuse to accept responsibility toward the neurotic patient without in effect encouraging the neurosis.
6. A skillfully conducted discussion of the situation under conditions of good rapport is often surprisingly effective therapy.

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POTENTIAL ANATOMICAL SPACES IN THE FACE

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INFECTIONS involving the deeper structures of the face present obvious difficulties to the surgeon because the clinical findings usually observed in abscess formations of the superficial structures are not available. Fluctuation following the usual signs and symptoms of infection is still the accepted criterion indicating the optimum time when incision and drainage are to be instituted. However, when deep structures are involved fluctuation is usually not present, although all other clinical findings point to the fact that accumulation of pus has taken place. The interpretation of the clinical findings and the surgical approach of the deep infections of the face depend on accurate knowledge of the anatomy of the face, the fasciae, and potential spaces which may harbor suspected infections.

In recent years the floor of the mouth, cervical fascia and potential spaces have been extensively studied but the deep anatomy of the face apparently remained neglected until Coller and Yglesias reported their findings in 1935.[6] These investigators have included all the potential spaces in the face in a group and called it the masticator space. In addition, they have described the so-called space of the mandible. A review of the literature since the publication of the findings of Coller and Yglesias reveals frequent references and quotations from their article. Grodinsky reported his study of the fasciae and spaces, but failed to mention the space of the body of the mandible.[12] Dorrance[8] and Dingman[7] discussed the presence of the space of the body of the mandible quoting the original publication by Coller and Yglesias. Like Grodinsky, New and Erich[17] reported their results of extensive studies of fasciae and potential spaces stressing the floor of the mouth and cervical fascia and its compartments. Considering the paucity of available information concerning the deeper structures of the face, this anatomical work was started with the hope that certain important factors might be uncovered which may aid the surgeon in a better understanding of the infections of the face and thus enable him to prognosticate the course of the infection and finally to institute proper and timely treatment.

METHODS OF STUDY

Dissections with special attention to the possible spaces and fascial distribution were carried out prior to the employment of the injection technic and roentgenographic studies. Because the great majority of infections of the face originate from the oral cavity and associated structures, the sites for injecting materials were determined by the suspected points of origin of an infection. It was soon learned that the spread of the material was similar, regardless of the point of insertion of the syringe. Plaster of Paris was the first material used but was discarded because the ramifications were thin and widespread and made subsequent dissection unsatisfactory. It was found useful in injecting well defined large spaces, especially where a cast of such a space would be desired. Some of the newer plastic impression materials used in dentistry were tried, but these proved to be unsatisfactory because of rapid chilling and their relative radiolucency. The material that was found most satisfactory, easy to manipulate and inexpensive was gelatine with sufficient amount of red lead added to make it radiopaque.

After several trials the following material was used: One tablespoonful of powdered gelatine was dissolved in four ounces

of water over a Bunsen flame. To this was added six teaspoons of red lead and mixed thoroughly. This material allows sufficient time for unhurried injection and produces satisfactory contrast against bone on the roentgenographic film. The injected specimens were subsequently roentgenographed, frozen, and then sectioned by means of employing an electrically driven band saw. The saw having four teeth in an inch of its length is the type ordinarily used in the manufacture of wood patterns.

Realizing the temptation of presenting questionable anatomical structures, diagrammatic drawings alone cannot be relied upon. Only actual photographs of sections and roentgenographs are shown. The drawings are those made directly from dissections made by the author and from sections whose photographs are herein presented.

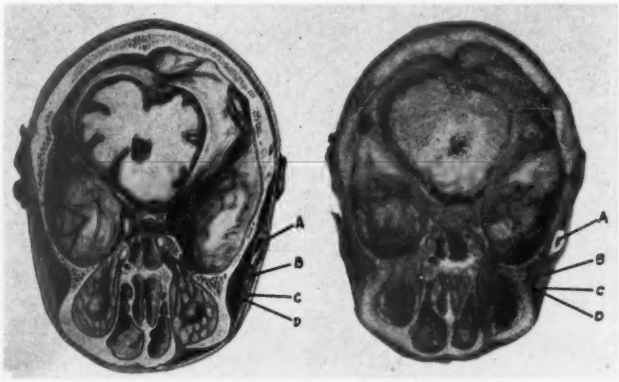


Fig. 1. Horizontal section of a head at a level of the supraorbital ridge showing the temporal space. A, rubber tube through which the radiopaque material was injected; B, temporal space; C, temporal fascia; D, temporal muscle.

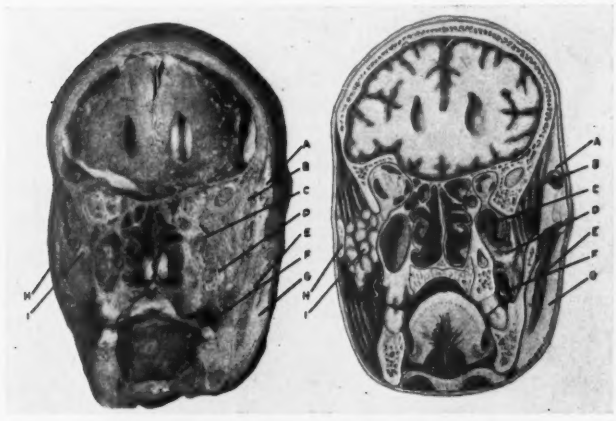


Fig. 2. Frontal section through the region of the ramus of the mandible showing the temporal and infratemporal spaces. A, temporal space; B, temporal muscle; C, internal maxillary artery; D, infratemporal space; E, masseter muscle; F, buccinator muscle; G, subcutaneous space; H, zygomatic arch; I, retrozygomatic fat.

Employing the technic described above, ten adult cadavers were studied. Pertinent anatomical findings are of value to the surgeon only when they serve to clarify inadequately understood regional anatomy and tend to explain the symptomatology of the parts involved. With this in mind the various spaces are described separately. This is followed by a discussion of the fasciae, their distribution and relation to spreading infections of the face.

TEMPORAL SPACE

This space, constituting the upper portion of the masticator space described by Coller and Yglesias, is bounded laterally by the thick temporal fascia which is firmly attached to the superior temporal line above.[6] Inferiorly it converges and splits into two layers which are attached to the lateral and medial surfaces of the zygomatic arch. The interval between the two layers is occupied by fat in which branches of the temporal and zygomaticoorbital arteries are found. Medially the temporal space is bounded by the temporal fossa which is made up by the squamous portion of the temporal bone, lower part of the parietal bone, a small portion of the frontal bone, and a part of the great wing of the sphenoid bone. This entire area serves as a site of origin of the temporal muscle. The medial and lateral boundaries approach each other posteriorly and superiorly at the temporal line. Anteriorly and inferiorly the position of the zygomatic arch separates the two boundaries markedly. Inferiorly the temporal space communicates widely with the medial portion of the masticator space. Antero-inferiorly it communicates with a space which the author proposes to designate as the retrozygomatic space.

The temporal muscle occupies practically all of the temporal space. Besides its origin from the bone the muscle presents numerous slips attached to the temporal fascia. The lateral aspect of the muscle itself is covered with a thin layer of fascia which becomes thicker inferiorly and is attached to the sigmoid notch of the ramus of the mandible. In addition to the temporal muscle this space contains a slight amount of fat, loose areolar tissue more pronounced near the angle formed by the zygomatic bone and the zygomatic arch, and the deep temporal vessels and nerves which supply the temporal muscle.

INFRATEMPORAL SPACE

The infratemporal space is confined in the infratemporal fossa and constitutes the medial portion of the masticator space. Medially it is bounded by the fusion of the buccinator fascia with the fascia covering the medial aspect of the internal pterygoid muscle. Posteriorly it is separated from the parapharyngeal space by the posterior border of the internal pterygoid muscle and its fascia. Laterally this space is bounded by the ramus of the mandible. The roof of the infratemporal space is formed by the temporal muscle and that part of the temporalis fascia that is attached to the sigmoid notch. Anteriorly and superiorly this space communicates freely with the temporal space beneath the cover of the zygomatic arch. It is also in wide communication with the retrozygomatic space and with the space superficial to the buccinator fascia occupied by the buccal pad of fat. Inferiorly the medial surface of the internal pterygoid muscle and its fascia limit the space by their attachment to the angle of the mandible.

The infratemporal space contains the external and internal pterygoid muscles, the pterygoid plexus of veins, the first two divisions of the internal maxillary artery and its branches and the inferior alveolar, mylohyoid, buccinator, lingual and chorda tympani nerves.

BUCCAL SPACE

Surgical consideration requires recognition of a space in the cheek beneath the skin and superficial fascia in the angle formed by the anterior border of the masseter muscle and the zygomatic bone. Medially this space is limited by the buccinator muscle and its fascia. Laterally it is bounded by the risorius, zygomaticus and the quadratus labii superioris muscles, skin and superficial fascia and occasionally by the platysma which may carry with it the deeper layer of the superficial cervical fascia. Posteriorly the anterior border of the masseter muscle and anteriorly the orbicularis oris muscle form its boundaries. Normally this space is occupied by the buccal pad of fat also known as the suc-

torial pad. The space and the fat is pierced almost at right angles by the duct of the parotid gland as it curves over the anterior

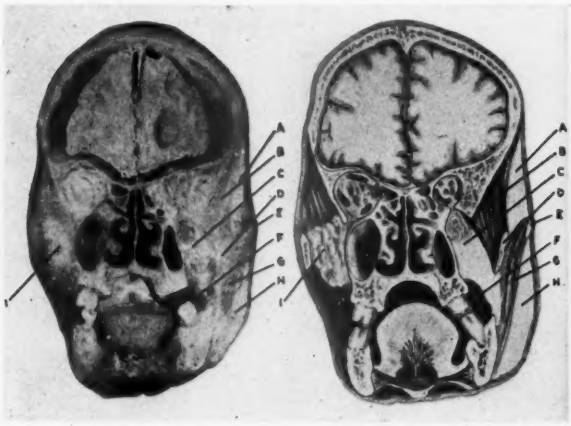


FIG. 3. Frontal section somewhat anterior to the section shown in Figure 2. The temporal, infratemporal and the retrozygomatic spaces are shown. A, temporal space; B, temporal muscle; C, intratemporal space; D, coronoid process of the mandible; E, zygomatic arch; F, buccinator muscle; G, masseter muscle; G, subcutaneous space; I, retrozygomatic space.

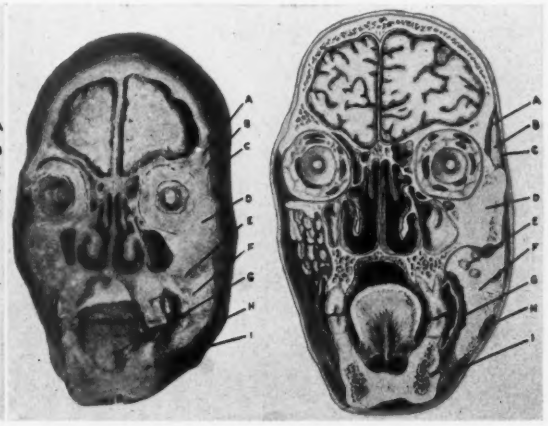


FIG. 4. Frontal section through the zygomatic bone showing the buccal space. A, temporal muscle; B, temporal space; C, temporal fascia; D, zygomatic bone; E, zygomaticus muscle; F, buccal space; G, buccinator muscle; H, risorius muscle; I, triangularis muscle.

border of the masseter muscle. A portion of the fat pad extends posteriorly beneath the masseter and the ramus of the mandible and becomes continuous with the adipose tissue of the infratemporal space. Superiorly a large process of fat extends and fills the retrozygomatic space.

RETROZYGOMATIC SPACE

Closed anteriorly by the union of the maxilla and zygomatic bones this horseshoe shaped space encloses an extension of the buccal fat. The fat surrounds the coronoid process of the mandible and the insertion of the temporalis muscle. Superiorly the space communicates with the temporal space. Posteriorly and medially with the infratemporal and inferiorly with the buccal space. The function of the fat in the cheek is questionable. It is believed to be of importance in the act of suckling and that is the reason for the term of suctorial pad. It is greater in abundance in the negro than in the white race. The presence of fat in the retrozygomatic space, however, appears to have a dual purpose. The first is to fill the space formed by the zygomatic eminence. The second reason for the presence of the fat in the retrozygomatic space can only be speculative in this paper. Its distribution about the coronoid process suggests that it may be instrumental in supplying a restricting force on the anterior and mediolateral movements of the coronoid process. The relatively small displacement observed in fractures of the coronoid process seem to support this theory. The fat contains only small caliber vessels and is lobulated in irregular masses separated by loose connective tissue.

FASCIAE

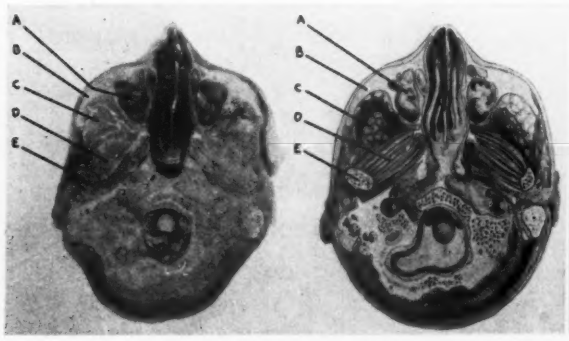
It is generally agreed that fasciae and their distribution play a very important rôle in infections, either by limiting them in confined compartments or by directing the spread of purulent material along planes or sheaths from one area to another. The confusing clinical picture so frequently observed in infections of the face results from the intricate distribution of the deep fascia and its relation to the various compartments described above.

The *superficial fascia* of the face is continuous with the scalp above and the superficial cervical fascia below. Primarily it consists of fibro-areolar tissue which

forms a loose network, the meshes being filled with lobules of fat of various sizes. The fatty layer is firmly adherent to the skin. On the face it presents certain peculiarities. In the eyelids the fat layer is absent and the fascia assumes a loose fibrous character. Beneath the skin of the nose the fatty layer is slight and fibroareolar connective tissue is the rule. Over the anterior portion of the face the superficial fascia is intimately connected with the muscles of facial expression into which it sends numerous fibrous processes. In the region lateral to the angle of the mouth it becomes more prominent with the buccal pad of fat. The character of this suctorial pad is similar to the fat of the superficial fascia and thus the buccal fat pad is looked upon as a part of the superficial fascia. In other parts of the body the superficial fascia covers the deep fascia. In the face the position of the suctorial fat pad is analogous in that it covers the fascia of the buccinator muscle. Posteriorly the superficial fascia extends and covers the fascia of the masseter muscle and the parotid gland.

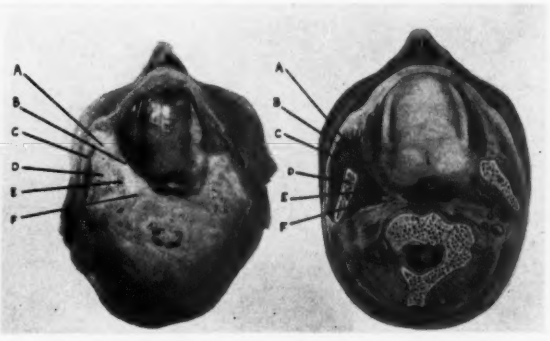
The *parotideomasseteric fascia* is an extension of the superficial layer of the deep cervical fasciae. It is attached at the lower border of the angle and posterior one-half of the body of the mandible. Superiorly it is attached to the zygomatic process and is continuous with the temporal fascia above. Anteriorly it dips around the anterior border of the masseter muscle, becomes thinner and perforated by a projection of the buccal fat and finally is continuous with the buccopharyngeal fascia. As stated above, this fascia is incomplete as it assumes a medial direction at the anterior border of the masseter muscle. This fact brings out an important clinical significance because an open space in a fascial plane may serve as an avenue for the spread of an infection. Posteriorly the fascia splits to form a capsule for the parotid gland. Above the zygoma this fascia becomes the superficial layer of the *temporal fascia* which covers the temporal muscle. It is tautly drawn between the zygoma and the superior temporal line which serves as its upper attachment. Above that line it is continued as the sub-aponeurotic layer of the glaea aponeurotica.

Below the lower border of the mandible the superficial layer of the deep cervical fascia is split. The medial plane extends upward and serves as the *fascia for the internal pterygoid muscle.* At the lower extremity of the internal pterygoid muscle this fascia is in apposition with the fascia



A B

Fig. 5. A and B. Horizontal section through the level of the zygomatic bone showing the retrozygomatic space. The injected material in Figure 5A is shown in black. A, maxillary zygomatic bone; C, retrozygomatic space; D, external pterygoid muscle; E, neck of the condyle of the mandible.



A B

Fig. 6. A and B. Horizontal section through the middle of the ramus of the mandible showing the free communication existing between the deep and superficial spaces of the face. Figure 6A is reversed. The injected material in Figure 6A is shown in black. A, buccal space; B, buccinator muscle; C, masseter muscle; D, ramus of the mandible; E, internal pterygoid muscle; F, parapharyngeal space.

of the superior pharyngeal constrictor muscle. These two planes are easily separated and a potential space is exposed known as the parapharyngeal space. At the anterior border of the internal pterygoid muscle the fascia turns laterally and becomes continuous with the fascia of the masseter muscle. As indicated above, however, there is a considerable defect anteriorly, which receives a portion of the buccal fat. The external pterygoid muscle is covered on its medial aspect by a continuation of the fascia which covers the internal pterygoid muscle. The *buccopharyngeal fascia* covers the lateral surface of the buccinator muscle. It is practically absent near the angle of the mouth but posteriorly it is of considerable thickness. It is attached to the periosteum of the alveolar process of the maxilla in the molar region. Below it fuses with the periosteum of the posterior portion of the mylohyoid line.

At the posterior extremity of the buccinabor muscle the buccopharyngeal fascia forms a tough band of tissue extending from the hamular process of the sphenoid to the posterior part of the mylohyoid line. This is the pterygomandibular raphe which serves as a site of attachment for the buccinator muscle anteriorly and the superior pharyngeal constrictor muscle posteriorly. From the pterygomandibular raphe posteriorly the buccopharyngeal fascia covers the superior constrictor muscle and forms the medial wall of the parapharyngeal space.

CLINICAL SIGNIFICANCE

Blair pointed out the importance of the buccinator muscle and its fascia in relation to the buccal spread of infections originating from the molar teeth.[5] Apical infections reaching the buccal plate of the maxilla beneath the attachment of the buccinator muscle point into the upper sulcus of the vestibule. These either rupture spontaneously into the mouth or may be drained surgically by incision through the mucous membrane. Similarly mandibular dento-alveolar abscesses which reach the buccal surface above the attachment of the buccinator muscle likewise

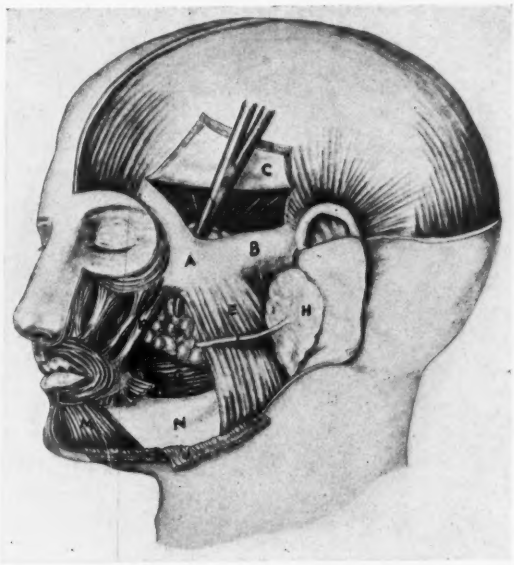
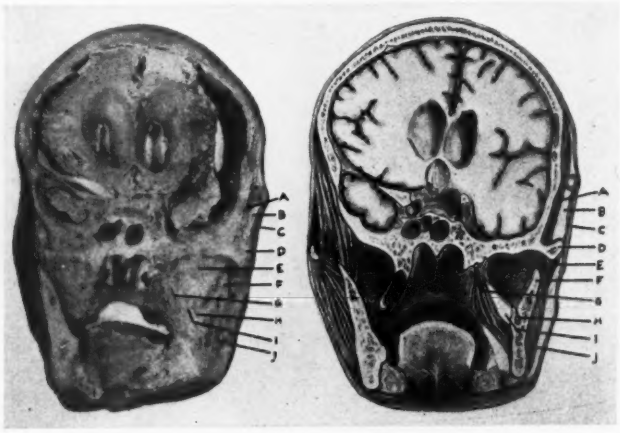


FIG. 7. Drawing made from a dissection showing the communication between the temporal and the buccal spaces. The instrument is shown passing through the retrozygomatic space. A, zygomatic bone; B, zygomatic arch; C, temporal fascia; D, temporal muscle; E, masseter muscle; F, buccal fat pad; G, buccinator muscle; H, parotid gland; I, parotid duct; J, platysma muscle; K, zygomaticus muscle; L, risorius muscle; M, triangularis muscle; N, mandible.

point into the vestibule where they may be evacuated with relative ease. Pus reaching the buccal surface below the attachment of the buccinator muscle in the case of the mandibular molars presents a problem of greater clinical significance. In either case the pus finds its way to the surface of the buccopharyngeal fascia which covers the buccinator muscle. If the first or second molars are the sources of the infection, the pus is usually confined in the buccal space beneath the suctorial pad of fat. It is possible that at any time during the course of an infection resolution may take place with consequent absorption of the purulent material resulting in abortion of the infection. This work deals primarily with the spreading infections which are of grave concern to the surgeon. Furthermore this investigative study is

intended to guide the surgeon in his care of the patient by presenting the pertinent regional anatomy and its influence on the spread of the infection. Once the buccal space is involved certain clinical findings may be observed. There is swelling of the cheek without observable redness. The mucosa of the mouth and gums appears normal and there is absence of trismus.



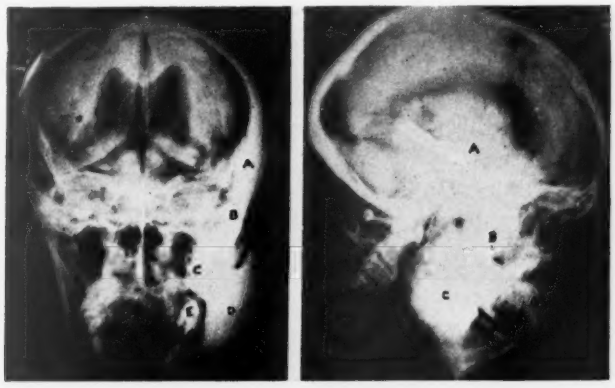
A B

FIG. 8. A AND B. Frontal section of a head through the ramus of the mandible showing the infratemporal space usually invaded by the hypodermic needle in blocking the mandibular nerve. A, temporal muscle; B, temporal space; C, temporal fascia; D, zygomatic process of the temporal bone; E, external pterygoid muscle; F, ramus of the mandible; G, internal pterygoid muscle; H, mandibular foramen; I, infratemporal space; J, masseter muscle.

From the buccal space the infection may take any of the following routes: (1) It may become subcutaneous and spread over the entire one side of the face and at times into the neck and pectoral region beneath the superficial fascia. (2) Because of the direct communication present the infection may enter the infratemporal space. (3) It may extend directly upward beneath the zygoma and involve the retrozygomatic space, and from there, (4) the temporal space may be involved. (5) Less frequently the infection spreads along the buccopharyngeal fascia and invades the parapharyngeal space.

Figures 8A and B show the area usually invaded by the needle in blocking the mandibular nerve. Infections of this space may be of dental, paradental, paracoronal or osteogenic origin in addition to direct introduction of infection by the needle. Before other clinical symptoms of infection are present one outstanding complaint is usually obtained from the patient, that of inability to open the mouth fully. Trismus then is present. Figure 8A shows the position of the internal pterygoid muscle which responds early to any irritation either of trauma or infection. As the infection of the infratemporal space progresses trismus becomes more pronounced and other clinical signs and symptoms become manifest. From the infratemporal space the purulent material gains ready exit anteriorly through the defect in the fascia described above and involves the buccal space. This fact has been observed clinically in spreading infections involving the face. That no barrier exists between the infratemporal and buccal space is brought out by Fouser who described some misadventures with conduction anesthesia resulting from injury of the pterygoid plexus of veins which are found in the infratemporal space.[10] He states: "In case the needle point punctures one of these thin-walled vessels, there is an immediate hemorrhage into the surround-

ing tissues. The blood which has escaped into the loose areolar tissue infiltrates the cheek. The blood then follows the loose connective tissues along the fascial plane of the muscles of the cheek and may only be limited in its downward course by the attachment of the buccinator muscle to the body of the mandible. The forward course of the blood is limited by the insertion of the muscle fibers of the buccinator muscle into the fibers of the orbicularis oris muscle."



A B

FIG. 9. A, roentgenograph of an injected head showing the distribution of the radiopaque material indicating the location of the spaces of the face; postero-anterior view. A, temporal space; B, retrozygomatic space; C, infratemporal space; D, buccal space; E, parapharyngeal space. B, roentgenograph of an injected head showing the distribution of the radiopaque material indicating the location of the spaces of the face; lateral view. The buccal space is superimposed on the infratemporal and parapharyngeal spaces. A, temporal space; B, retrozygomatic space; C, buccal space.

Upward extension of the infection from the infratemporal space may involve either or both the retrozygomatic and temporal spaces. In either case trismus is markedly increased because the temporal muscle becomes involved in addition to the internal pterygoid muscle.

Isolated infection of the retrozygomatic space probably does not exist unless it may become involved secondarily to an osteomyelitis of the zygoma. This space, however, assumes importance because of its position serving as an avenue of communication between the infratemporal and temporal spaces. Because of its recessed position and because it is devoid of sufficient blood supply infections in the retrozygomatic space may persist for a long time and may manifest themselves by repeated facial and temporal abscesses. Gillies, Kilmer and Stone recognized the direct communication between the retrozygomatic space when they described the method of external approach in reducing zygomatic fractures.[11] The method consists of inserting an instrument beneath the temporal fascia and passing it down beneath the zygomatic bone and zygomatic arch. Infections likewise may travel unimpeded from the retrozygomatic space into the temporal space. Temporal abscesses present uniform swellings above the zygomatic arch. Because of the toughness of the fascia fluctuation by means of palpation is not readily demonstrated. Spontaneous external rupture of a temporal abscess is infrequent, because of the character and thickness of the fascia. Many investigators make reference to superficial and deep temporal abscesses. In this reclassification of spaces of the face and deep temporal abscesses are those infections which are confined in the infratemporal space. Infections originating in

the temporal space may by downward progress involve the infratemporal and retrozygomatic spaces and from there the buccal and parapharyngeal spaces. At the medial aspects of the angle of the mandible, anterior to the insertion of the internal pterygoid muscle the infratemporal space is approximated by the deep fascia covering the submaxillary gland. The gland may become involved secondarily to infections of the infratemporal space or there may be a direct extension of infections of the third mandibular molar to the submaxillary space. Slightly posteriorly and along the buccopharyngeal fascia the parapharyngeal space is located. Figure 8B shows the possible spread of infection which may involve the floor of the mouth by extension of the purulent material from the infratemporal space anteriorly either above or below the mylohyoid muscle.

Coller and Yglesias described a space which they designated as the space of the body of the mandible.[6] The mandible is covered with periosteum which serves also as a means of attachment of muscles and fasciae. All spaces described are only potential spaces which assume clinical importance when infectious material becomes confined or trapped within them. It should be possible to inject potential spaces in the laboratory if such spaces exist. This work cannot confirm the presence of the so-called space of the body of the mandible.

SUMMARY AND CONCLUSIONS

1. Proper management and the interpretation of the clinical findings and the surgical approach of the deep infections of the face depend on accurate knowledge of the anatomy of the face, the fasciae, and the potential spaces which may harbor infections.

2. Because of the close proximity of the region studied to the oral cavity the greater majority of the infections are of dental, paradental and osteogenic origin.

3. The anatomical study of the deep structures of the face, the fasciae, and potential spaces consisted of dissection, injection of spaces with radiopaque materials followed by frontal and horizontal section.

4. The following spaces or compartments were found by the above method and are here described: (1) temporal, (2) infratemporal, (3) retrozygomatic, and (4) buccal.

5. The infratemporal, retrozygomatic and the buccal spaces as such are described for the first time. The temporal space is included in order to bring out its relation to the spaces mentioned above.

6. The spaces described are not entirely bounded by fascia. Bones, muscles, fasciae and skin make important contributions in the intricate make-up of the spaces in the face.

7. Communications between the various spaces are demonstrated which indicate the possible avenues of the spread of infections.

8. Communication between deep and superficial spaces is demonstrated.

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IT must be understood that *routine wound excision has no place in facial surgery*. That same copious blood supply, which in face wounds is often responsible for profuse and even dangerous haemorrhage, will often ensure the viability of flaps almost completely detached and is responsible for the rarity of serious spreading infection. Gas gangrene is unknown.

From "Surgery of Modern Warfare" edited by Hamilton Bailey (The Williams and Wilkins Company).

UROLOGICAL MANIFESTATIONS ASSOCIATED WITH CHRONIC APPENDICEAL ABSCESS

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MEDICAL literature abounds in instances of urological syndromes resulting entirely from lesions outside the genitourinary tract. The majority of these extraneous lesions originate in the intestinal tract. Less frequent, however, have been reports dealing with cases of acute appendicitis giving rise to urinary symptoms. A cursory review of the literature reveals a paucity of material dealing with the subject of chronic appendiceal abscesses in the field of urologic practice. While it is the purpose of this communication to discuss the problem of the chronic appendiceal abscess with regard to its occasional tendency to give rise to urological syndromes, it would not be amiss to review briefly the readily available literature pertaining to the subject of urological manifestations of appendicitis in general.

As far back as 1896 Deaver, in his treatise on appendicitis, mentions this relationship, and attributes the urological symptoms associated with appendicitis to irritation of the sympathetic nervous system.

The problem of hematuria associated with appendicitis has been discussed by a number of observers (Speed, Packard, Becke). Speed reports that in seven patients out of thirteen with acute or subacute appendicitis, the urines at the time the patients were admitted to the hospitals revealed from 50 to 200 erythrocytes per high power field. Following appendectomy, the urines were free of red blood cells. This author has tabulated the causes of hematuria as (1) ureteritis; (2) periureteritis; (3) cystitis; (4) pericystitis; (5) septic infarcts to kidneys, ureters, bladder and prostate; (6) toxic hematuria; and (7) lighting up of an old urethritis by an acute febrile attack resulting from appendicitis. He believes, however, that the most likely cause of the hematuria is a periureteritis caused by an appendix lying in close proximity to the right ureter.

Packard reported an instance of appendicitis associated with hematuria, apparently originating in the right kidney, but on passing a ureteral catheter into the renal pelvis, urine obtained from the pelvis showed no red blood cells. A somewhat similar case was described by Becke, in which the right kidney was removed because it was believed to be the source of hematuria. Examination of the extirpated kidney disclosed no abnormality, but a subsequent operation revealed the appendix adherent to the stump of the right ureter.

Instances of pyuria associated with appendicitis have also been reported. Harbin believes that pyuria accompanying acute appendicitis is due to pyelitis, which in turn results from a metastatic infection originating in a focus which is also responsible for the appendicitis. In chronic cases he is inclined to believe that the organism, which is usually the Bacillus coli, gains access to the kidney by way of the ureteral lymphatics from the affected appendix. Van Duzen reviewed a series of 300 cases of pyelitis and attributed the probable cause to an infected appendix in 7.6 per cent of them.

An interesting case of massive pyuria resulting from rupture of an appendiceal abscess into the bladder was encountered by Keene and cited by Kelly and Hurdon in their treatise, "The Vermiform Appendix and its Diseases" published in 1905. Nielson in a paper published in 1932 deal-

ing with this subject was able to collect twenty cases of this type from the available literature.

Reports dealing with vesico-appendiceal fistulas are meager. In Kelly and Hurdon's book a case of Kindgon is cited in which a patient passed worms through the urethra, and urine in the stool. Postmortem examination disclosed an appendix which was adherent to and communicated with the bladder.

A case of reflex anuria associated with appendicitis was reported by Abdanski in 1929. Cope maintains that appendicitis in males is associated with testicular pain in 5 per cent of cases, and attributes this to irritation of the sympathetic nerves situated in the wall of the right spermatic artery. He also attributes the phenomenon of right costovertebral tenderness frequently associated with inflamed appendices lying in retrocolic position to irritation of the tenth dorsal spinal nerve which is supposed to innervate the appendix. Retraction of the right testicle has been occasionally noted associated with acute appendicitis and is believed to be due to contraction of the cremaster muscle from irritation of the right genitocrural nerve.

An unusual case of priapism associated with appendicitis was described by Long in the course of a discussion of a paper written by Harbin. In this case the appendix was gangrenous and was found lying in close proximity to the right ureter.

An interesting case was recently described by Ehlert, of a boy fifteen years of age, who was admitted to the urologic service complaining of dysuria, inability to void, chills, fever, nausea and vomiting. The urine was cloudy due to pus cells, and on physical examination a mass was felt above the symphysis pubis. The diagnosis was acute cystitis with urinary retention. Postmortem revealed a generalized peritonitis due to a ruptured gangrenous appendix which was situated directly in the midline, on top and slightly in front of the bladder, and adherent to the bladder.

CASE REPORTS

The three cases about to be presented are unique in that few if any similar cases have been previously reported.

Case 1.* Mr. R. D., aged fifty-five, was seen by us December 18, 1941, complaining of dysuria, diurnal and nocturnal urinary frequency and pain in the urethral meatus. The past history was uninformative.

For the past six months he had been complaining of a sense of fullness in the perineum, with dysuria and increased diurnal and nocturnal frequency, voiding eight times during the day and three times at night. Lately he experienced pains in the meatus and suprapubic discomfort. During the past few weeks he had had bouts of diarrhea and rectal tenesmus. There was a loss of ten pounds in weight during the past six months.

A No. 21 Brown Buerger cystoscope was introduced into the bladder with considerable difficulty due to marked spasm in the region of the sphincter. Bladder capacity was reduced and there was a well defined median bar and collar contracture of the vesical neck. The base of the trigone was narrowed.

Rectal examination disclosed a stony-hard "shelf" situated above the upper border of the prostate gland, involving the anterior wall of the rectum, and extending half-way around the circumference of the rectum. The mucous membrane covering the "shelf," however, appeared to be intact. The prostate was small and of normal elasticity.

Physical examination revealed a well developed male who did not appear acutely ill. Save for the rectal findings above described, the physical examination was essentially negative.

Roentgenological examination of the urogenital tract revealed nothing abnormal.

Barium enema roentgen study disclosed a suspicious ragged deformity in the region of the rectosigmoid.

Sigmoidoscopy revealed the following: Situated about three inches from the external anal sphincter there was a nodular shelf involving the anterior rectal wall. Three specimens were taken for biopsy from different parts of the lesion. These were reported "inflamed fibroadenomatous rectal polyp showing prominent

*J. A. L. reported in *J. Urol.*, vol. 50, no. 1, July, 1943.

mitoses. There is no epithelial cell invasion of the stroma. The glands appear regular."

Although it was believed that we were dealing with a typical "Blumer's shelf," absence of distinct evidence of malignancy in the biopsy specimens warranted an exploratory laparotomy.

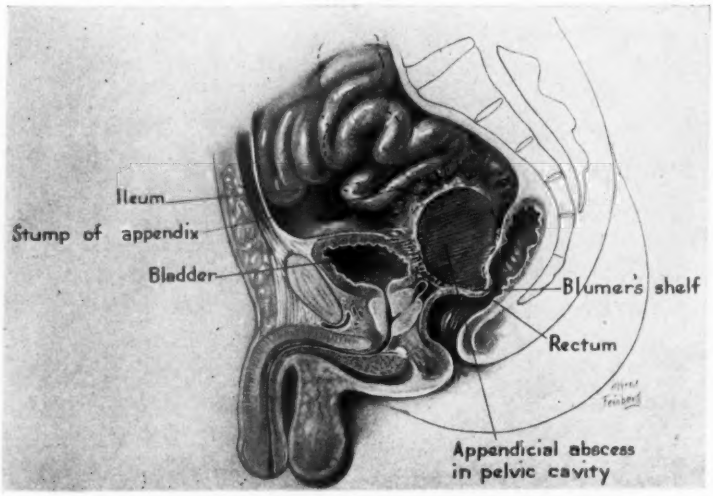

FIG. 1. Diagrammatic sagittal view showing relationship between abscess cavity, bladder, stump of appendix and rectum. (Note formation of Blumer's shelf.)

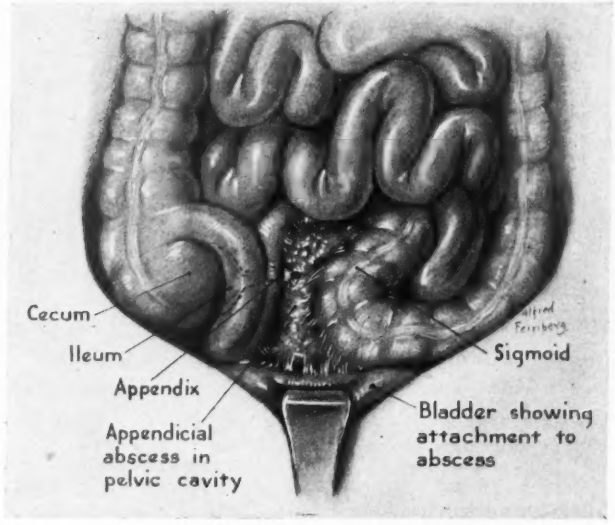

FIG. 2. Diagrammatic view showing relationship between abscess cavity and bladder, sigmoid, terminal ileum and appendiceal stump.

Operation was performed on January 9, 1942. (Figs. 1 and 2.) Under spinal anesthesia the abdomen was opened through a four-inch left paramedian suprapubic incision. A mass the size of a large orange was found situated deeply in the pelvis behind the bladder. This mass comprised the mesial wall of the sigmoid flexure lying to the left, the terminal portion of the ileum to the right, the posterior wall of the bladder ventrally, and the promontory of the sacrum situated posteriorly. Planted directly into the center of the mass was the proximal half of the vermiform appendix, the terminal portion of which had completely sloughed off. The sigmoid flexure and ileum were densely adherent to the mass. A collection of thick, inspissated, putty-like material was found in the center of the area of tumefaction. The proximal half of the appendix and its mesentery were thickened but the caput coli was in no way involved.

With the patient in high Trendelenburg position, the abdominal contents were displaced caudally and held in place with warm packs, thereby clearly exposing the pelvic lesion. The sigmoid and terminal ileum were carefully separated and freed from the bladder by blunt gauze dissection. The proximal half of the appendix was freed and removed in the usual manner and its stump carbolized but not inverted. The thick inspissated pus was evacuated by suction and 10 Gm. of sulfanilamide crystals was evenly distributed within the abscess cavity. A rubber dam drain was placed deeply into the pelvis behind the bladder, and two small rubber tubes were introduced in the immediate vicinity of the appendiceal stump. The wound was closed in layers around the drains.

Recovery was completely uneventful. The rubber dam was removed on the sixth postoperative day and the sutures on the seventh. All drains were out on the eleventh day, and he was discharged from the hospital on January 22nd, thirteen days after operation. When last seen he was symptom-free, and the rectal shelf had completely disappeared.

Comment. This case presents a number of interesting and unusual features. Here we have a patient who presented himself with symptoms of prostatism and who, following a cystourethroscopic examination, was found to have a well defined median bar and contracture of the vesical neck. Careful interrogation failed to elicit a history even remotely suggestive of appendicitis. Upon rectal examination, however, a rectal "shelf" was found which usually signifies the presence of a metastatic lesion in the cul-de-sac and therefore an inoperable condition. Yet, surgical intervention disclosed the underlying cause of this patient's difficulty to have been an old appendiceal abscess which, because of its location, gave rise to symptoms of prostatism and also to the development of a pelvic ridge which was highly suggestive of a "Blumer's shelf." Following appendectomy and drainage of the abscess cavity, all symptoms disappeared, including the "rectal shelf."

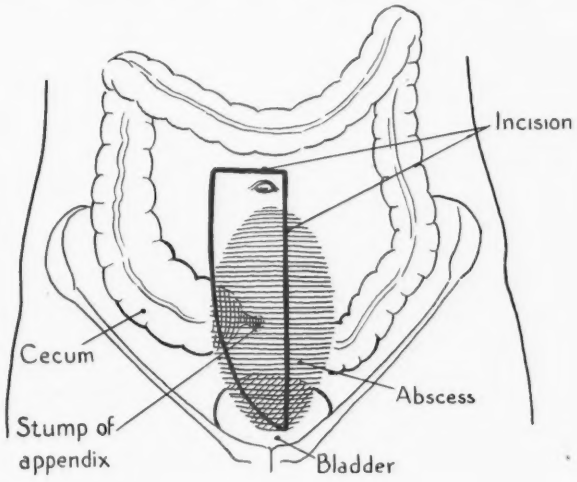

Fig. 3. Schematic drawing, anteroposterior view, illustrating the relative position of the abscess cavity to the anterior abdominal wall, cecum and bladder, and the line of incision.

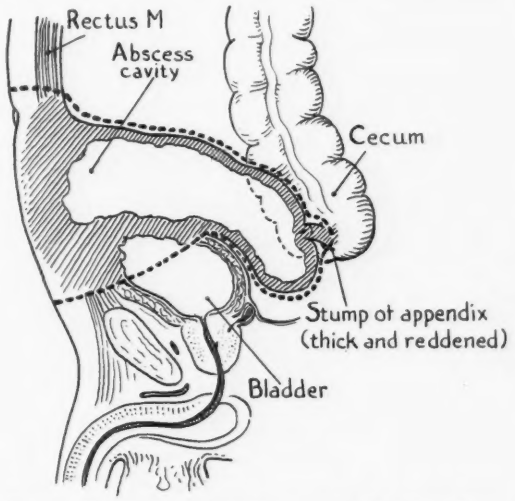

Fig. 4. Schematic drawing, sagittal view, showing the position of the abscess cavity to the anterior abdominal wall, cecum and bladder. The dotted line shows the extent of removal of the anterior abdominal wall in the operative procedure.

Case II.* N. L., aged fifty-two, seen September 19, 1942, complained of increased urinary frequency, nocturia, backache and loss of weight (twenty pounds). He was observed at one of the metropolitan hospitals where a diagnosis of carcinoma of the prostate was made. Before submitting to surgical interference, he insisted upon another opinion.

Cystoscopy revealed a well defined median bar with slight congestion of the verumon-

*J. A. L. reported in *J. Urol.*, vol. 50, no. 4, October, 1943.

tanum. There was no evidence of lateral lobe enlargement. By rectum the prostate felt normal in size and consistency. Situated above the upper margin of the prostate there was a rigid, bar-like structure.

Barium enema disclosed no evidence of disease in the colon.

Physical examination showed an acutely ill male, who presented no findings other than those mentioned above. Temperature was 102°F.; blood count: hemoglobin 10.6 Gm. per 100 cc. of blood; erythrocytes 3,900,000 per cu. mm.; leukocytes 20,300. Polymorphonuclears 67 per cent. Urinalysis was essentially negative.

Preoperative diagnosis: Pelvic abscess in juxtaposition to bladder (appendiceal abscess).

Operation was performed on September 24, 1942. Under spinal anesthesia the abdomen was opened through a four-inch right paramedian incision. The serosa of the small intestine was injected. There was a small amount of serosanguineous fluid in the peritoneal cavity. Situated deeply in the pelvis there was a large mass, the left boundary of which consists of the mesial surface of the sigmoid flexure. A loop of indurated, injected terminal ileum was adherent to its upper surface. The posterior wall of the bladder formed its anterior boundary, while the caput coli, which appeared to be uninvolved, was situated to the right and directly above it. The appendix was not immediately visualized. After separating the loop of ileum from the mass, an abscess cavity was encountered and much pus evacuated. Careful blunt dissection of the ileocecal region showed the stump of the appendix to measure approximately 1.5 inches. The distal portion of the appendix was found completely sloughed off.

The appendiceal stump was extirpated and the cavity drained. Eight Gm. of sulfanilamide were salted into the pelvis. The patient was discharged from the hospital symptom-free on October 8, 1942.

Case III. Mr. C. K., aged fifty-nine, was seen November 5, 1943, complaining of a suprapubic swelling, dysuria, increased diurnal and nocturnal urinary frequency and loss of weight extending over a period of a few months. About two and one-half years previously he experienced an attack of pain in the right lower quadrant accompanied by vomiting. During and after this episode, he was examined in the out-patient department of a large metropolitan hospital and dilute hydrochloric acid was prescribed. Although the acute pain subsided in ten days, during the next two years he suffered from bouts of diarrhea alternating with constipation. About two or three months ago a swelling appeared in the lower abdomen, and he began to complain of urinary symptoms as previously mentioned.

Physical examination showed an emaciated male about sixty years of age, who looked chronically ill, and disclosed a hard, ovoid, non-tender mass in the midsuprapubic region, extending from the symphysis pubis to the umbilicus. Large lymph nodes were palpable in both groins. Blood pressure was 115/80. Rectal examination was negative; the prostate was slightly enlarged and firmly elastic.

A No. 21 Brown-Buerger cystoscope was easily introduced into the bladder. There was 6 ounces of amber, clear, residual urine. Situated on the upper posterior wall of the bladder there was a nodular intrusion about the size of an English walnut. The mucosa covering this nodular area of bladder wall was smooth and not ulcerated. There was a collar contracture of the vesical neck, with slight hypertrophy of the lateral lobes of the prostate.

Urinalysis revealed the following: Specific gravity 1.004; albumin and sugar negative; microscopic 1–2 leukocytes and an occasional erythrocyte per high power field. Bacteriology of bladder urine: Negative on smear and sterile on culture; Tbc negative.

Blood Wassermann negative.

Preoperative diagnosis: (1) Intra-abdominal carcinoma involving the bladder; (2) sarcoma of the abdominal wall involving the bladder.

Operation was performed on November 6, 1943, by one of us (J. A. L.): Under spinal anesthesia (tropococaine) a midline incision was made commencing at the symphysis pubis and extending upward above the umbilicus to the left of the midline for a distance of three inches. An attempt to enter the peritoneal cavity directly above the symphysis was unsuccessful because of the sclerotic character of the tissues beneath the skin. It was only after the incision had been lengthened above and to the left of the umbilicus that the peritoneal cavity could be entered.

Situated in the midportion of the abdomen and extending from the symphysis pubis to

the umbilicus there was a mass of stony-hard consistency. The lower portions of both recti muscles directly over the area of tumefaction felt sclerotic. The mass was firmly adherent to the vault of the bladder. The cecum was adherent to its posterior surface, and after careful dissection the appendiceal stump, thickened, reddened and with indurated mesentery, anchored the caput coli to the center of the area of tumefaction. It was now evident that we were dealing with an old chronic indurated abscess resulting from a gangrenous appendix which had ruptured into the anterior abdominal wall. The wall of the abscess was markedly sclerotic, and about three ounces of thick, inspissated pus was found within the center of the mass. A portion of the bladder vault was intimately adherent to the abscess wall. (Figs. 3 and 4.)

After entering the peritoneal cavity the intestines were carefully packed off into the upper abdomen and the borders of the mass clearly defined. The base of the appendix was crushed, and divided with a carbolized knife between two ligatures, and the cecum replaced into the upper abdomen. The abscess cavity was opened and about three ounces of pus evacuated. In order to extirpate the area of tumefaction completely, it was necessary to remove a portion of the bladder vault to which it was intimately adherent. The bladder wall was closed around a tube with two layers of fine chromic catgut. Ten Gm. of sulfanilamide crystals were evenly distributed through the pelvis and around the bladder. The reconstructed bladder was extraperitonealized by approximating the peritoneum covering the psoas muscles on either side of the bladder and to the serosal layer of the rectosigmoid. The abdominal wall was closed with a series of heavy silk sutures, incorporating all layers of the abdominal wall except the skin which was closed separately with interrupted silk sutures. Drainage consisted of one packing and one rubber tube to the space of Retzius and one packing and one tube to the space above the bladder.

Comment. This is a case of an old chronic appendiceal abscess in a male patient who showed a large midline suprapubic tumor, and who complained of dysuria, increased diurnal and nocturnal urinary frequency and loss of weight. About two and one-half years previously he experienced an attack of what now appears to have been acute appendicitis, but which had not been recognized as such at that time. For two years thereafter he had bouts of diarrhea and constipation. During the past two months he noted a swelling in the lower abdomen and began to complain of urinary symptoms. Operation disclosed an old appendiceal abscess involving the anterior abdominal wall and a portion of the vault of the bladder.

SUMMARY AND CONCLUSIONS

Acute appendicitis can give rise to urological symptoms. A brief review of the literature pertaining to this subject is presented in an attempt to emphasize the motivating causes of these urological manifestations. Three unusual cases of chronic appendiceal abscess with unusual urological features are presented.

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INTRASTERNAL INFUSIONS IN OBSTETRICAL HEMORRHAGE*

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THE conquest of hemorrhage has played a major part in the reduction of maternal mortality in the last decade. The intravenous infusion of blood and plasma has become so easy and safe, this procedure is now relegated to the junior intern or, in many clinics, to the nursing staff. But the veins may fail us when we need them most, as in patients with very severe hemorrhage when the peripheral venous system is found to be collapsed.

In this desperate situation or when for any other reason the intravenous route is not available, we have found the recently developed method of intrasternal infusion of tremendous value in obstetrical hemorrhage.

In the treatment of pernicious anemia Josefson,[1] in 1934, injected a liver preparation intrasternally. In 1940, Tocantins[2] bled rabbits and reinfused the blood into the bone marrow of the tibia. He noted that the hemoglobin and red blood cell counts returned to normal in twenty-four hours. He then demonstrated that mercury injected into the human sternum soon issued from the severed internal mammary veins on the undersurface of the sternum. Next Tocantins infused saline solution into the sternum of three men successfully. He stated that the intrasternal route may offer one more means of administering parenteral therapy when speed was desirable and the usual pathways unsuitable.

In 1940, Tocantins and O'Neill[3] administered citrated blood, plasma, and glucose-saline solutions to adult patients via the sternum and used, with equal success, the tibia and femur of children. No local or constitutional reactions were observed clinically or by *x*-ray.

Henning,[4] in 1940, proved that substances injected into the medullary cavity rapidly find their way into the circulation. He pointed out that in military surgery this would have many advantages. The sternum is always readily accessible and the needle is firmly fixed in the compact layer of bone and is not easily dislodged in restless patients or those who must be transported considerable distances.

Meyer and Perlmutter[5] demonstrated that the circulation times tested with saccharin, arm to tongue and sternum to tongue, were essentially the same.

Subsequent articles by Tocantins and O'Neill et al.[6–10] have demonstrated the value and safety of this method. Papper and Rovenstine[11] and others have also shown the value of osteoclysis. The latter two workers reported easy and rapid anesthesia with sodium pentothal administered through the sternum.

TECHNIC

The skin over the sternum is prepared with alcohol and iodine. A 1 per cent solution of procaine is infiltrated into the skin, subcutaneous tissue, and the periosteum in the midline over the manubrium or over the body of the sternum below the angle of Louis.

An ordinary B-D 15 gauge needle $1\frac{5}{16}$ inch long with a stylet is then inserted vertically with bevel up through the periosteum. With the needle then tilted at a thirty degree angle to the skin moderate firm constant pressure is used until a

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sensation of "give" occurs; this indicates piercing of the anterior plate of the sternum. The end of the needle now lodges in the marrow cavity. The needle is held firmly in place by the bony plate. A 2 cc. syringe with 1 cc. saline is connected to the needle and 0.1 to 0.2 cc. blood-marrow mixture are aspirated. Next 2 cc. saline are injected slowly into the sternum. To prevent marrow clotting in the needle the adapter of the tubing connected to the usual gravity infusion apparatus is then quickly attached to the needle in the sternum. The rate of flow is adjusted according to the needs of the patient. The needle and surrounding area are covered with sterile gauze.

Only in the event of deep shock is it deemed advisable to inject blood or plasma rapidly with a large syringe directly into the sternum. The rate of flow may diminish after some hours or the flow stop, but this is remedied by reinserting and removing the stylet and injecting 2 cc. of saline under slight pressure. This may cause slight discomfort to the patient locally. In this same manner, when the patient has received adequate fluids, the gravity infusion apparatus is disconnected, the stylet inserted into the needle and sterile dressings placed over this. The next day the stylet may be removed, 0.5 cc. saline injected, 0.1 cc. blood-marrow mixture aspirated, 2 cc. saline injected and the administration of blood and other fluids started again. The needle has thus been allowed to remain for six days.[11] Doud and Tysell[12] in a case of uncontrollable bowel hemorrhage in ulcerative colitis permitted the needle to remain in place five days and one day later reinserted it for four days without aftereffects. Fluids may be permitted to run through two needles at the same time, one in the manubrium and one in the gladiolus.

PRECAUTIONS

1. Strict asepsis should be maintained from the time the skin is prepared for procaine infiltration until after removal of the needle, when the site is again prepared with alcohol and iodine and a sterile dressing applied.

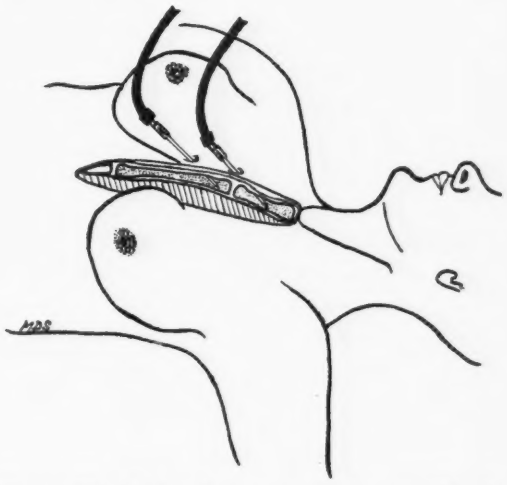

FIG. 1. Sketch showing one needle in sternal body and one needle in manubrium.

2. Osteoclysis is contraindicated in cases with septicemia.

3. One should guard against piercing the posterior sternal plate. The sternum in infants and children is poorly developed and should not be used.

4. If marrow cannot be aspirated, fluid must not be injected. The lower femur or tibia has been used satisfactorily and may then be used. In children only the latter sites should be selected.

5. Not more than one puncture should be made in the manubrium unless twelve hours have elapsed. An unsuccessful puncture in the body of the sternum at one place may be repeated only at some distance from the first. Some of the fluid running through the second puncture may flow out of the first puncture if the pressure be great enough and the openings close together.

6. Circulatory overloading is to be avoided as with intravenous administrations.

7. Hypertonic and irritating solutions should not be used.

INDICATIONS

The intrasternal route may be used when there is profound shock with collapse of

the peripheral veins, when rapid massive administrations of blood, plasma, and other fluids are desirable and when the time-consuming dissection of veins might be disastrous. Frequently when such veins are isolated they are found to be collapsed or are too small for the rapid infusion of fluids. Other conditions in which the intrasternal route is recommended are widespread burns, mutilations, (as when the extremities have been amputated), thrombosed veins from repeated intravenous injections, patients requiring long-continued parenteral fluid therapy and in very restless patients. In infants and children, as stated above, the femur or tibia should be used.

CASE REPORTS

The following cases are reported to demonstrate the value of intrasternal infusion in obstetrics:

Case 1. No. 441617. Mrs. S., a thirty-eight-year-old quadripara, was admitted to the Carney Hospital, April 3, 1944. One hour before admission she was awakened during the night by vaginal bleeding.

The last menstrual period occurred six and one-half months previously and her pregnancy had progressed normally up to the present time. She had three previous transverse cervical cesareans. The first was performed for cephalopelvic disproportion after a sixteen-hour trial labor. The other two were performed electively. There had been no serious illnesses and no other operations.

On physical examination the patient was well nourished but with noticeable pallor of the face and mucous membranes. The temperature was 99°F., pulse 88, and respirations 22. The heart rate was regular. The blood pressure was 110 systolic, 60 diastolic. There was slight cardiac enlargement, a systolic thrill, and a blowing apical systolic murmur. The fundus was three fingers above the umbilicus. The uterus was flaccid and nontender, and the fetal heart rate was 136. The hemoglobin was 55 per cent with 2.58 million red blood cells, 7,100 white blood cells. The blood Hinton was negative. The patient was RH positive, and the urine was normal except for a few pus cells.

The flowing subsided soon after admission and the following day the patient received 500 cc. citrated blood. For the next four days there was occasional staining. For three days there was no further showing of blood and the patient was permitted to get out of bed. The following day a sudden profuse hemorrhage occurred. An intravenous whole blood transfusion was started and the patient was taken to the operating room. Under spinal anesthesia a transverse cervical cesarean section was performed with the delivery of a living female infant weighing 2 pounds, 10 ounces; $\frac{1}{320}$ gr. of ergonovine malleate was given intravenously. A central placenta previa was found and after removal of the placenta there was free bleeding from the placental site which was controlled by pressure. The fundus contracted well. The operation was speedily completed but when the skin was being sutured the patient began to bleed profusely from the vagina. The blood pressure dropped until it could not be obtained and the patient became pulseless. She was placed in deep Trendelenburg position, the cervix was exposed with a speculum, and the uterine cavity and vagina were firmly packed with a gauze strip impregnated with sulfanilamide. It was noted that the blood transfusion had stopped running. Veins were exposed by incision but were found to be collapsed. The patient appeared to be in extremis. After preparation of the skin over the sternum with alcohol and iodine but without local anesthesia, a No. 15 needle was inserted into the body of the sternum and blood and plasma administered rapidly by this route. Twenty minutes later the radial pulse was felt feebly at 130 per minute and the blood pressure was found to be 40/0. The patient was kept for the ensuing three hours on the operating table where she received intrasternally a total of 1,500 cc. whole blood, 1,000 cc. plasma, and 500 cc. physiologic saline. The blood pressure gradually rose to 95/60 at the end of the three hours and the pulse was of fair quality, rate 120, and the patient was returned to the ward where an additional 1,000 cc. of whole blood were given. It was later possible to enter a small vein in the right arm and when the intravenous solution was running well six hours after the operation and the blood pressure and pulse were satisfactory the needle in the sternum was removed, alcohol and iodine were applied to the site of

sternal puncture and a dry sterile dressing applied. During the next twenty-four hours 3,000 cc. of 5 per cent glucose and saline at 11:30 A.M. she complained of pain in the lower abdomen and back particularly at the left lower quadrant. At 7 P.M. of the same day

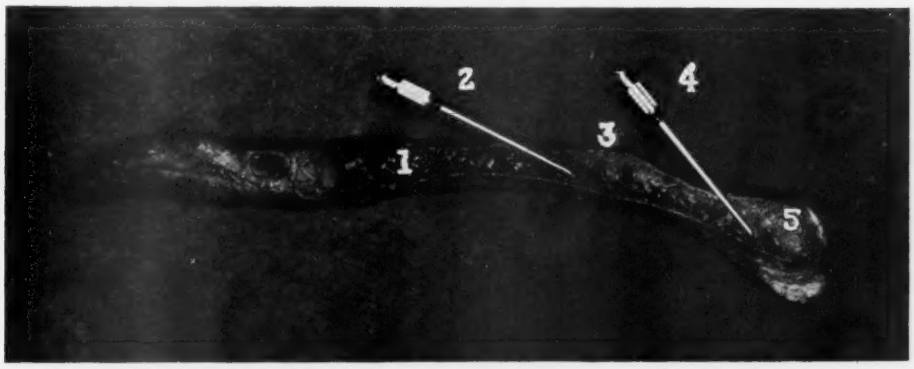

Fig. 2. Longitudinal section through the human sternum. 1, body of sternum; 2, needle in body of sternum; 3, angle of Louis; 4, needle in manubrium; 5, manubrium.

were given intravenously together with 5 Gm. of sodium sulfadiazene and 80 cc. of 1 molar sodium lactate.

For the next six days the patient received 1 Gm. of sulfadiazene every four hours with an equal amount of sodium bicarbonate by mouth. Eighteen hours after operation and after getting 2,500 cc. whole blood the red blood count was 1.5 million with a 35 per cent hemoglobin. This revealed the degree of blood loss that had occurred; 2,000 cc. whole blood were given during the second and third postoperative days. The temperature rose to 101°F. on the second postoperative day and thereafter remained below 99°F.

There was slight vaginal oozing of blood for one and a half days. The uterovaginal pack was removed on the second day.

The patient was discharged on the nineteenth postoperative day in excellent condition with a hemoglobin of 75 per cent and a red blood count of 3.4 million.

Case II. No. 442609. Mrs. R., a thirty-one year old female, was admitted to the Carney Hospital at 12 noon on June 4, 1944, complaining of lower abdominal pain and slight vaginal bleeding during the previous forty-eight hours. She had a normal full term pregnancy in 1933 and a miscarriage at two months in 1937. She had always been in good health and had had no operations. Her last regular menstrual period occurred on April 5th and was normal in all respects. On May 2nd and for the ensuing two weeks she had slight vaginal bleeding with the passage of a few small clots but there was no associated pain. On June 2nd she began to have some slight vaginal staining. About twenty-four hours later on June 3rd, she experienced pain in the right shoulder followed in a few minutes by pain in the left shoulder.

Physical examination revealed a well developed and somewhat obese young female complaining of lower abdominal pain. The blood pressure on admission, was 130/90, pulse 110 of fair quality, temperature 98.4°F. Her abdomen was moderately distended and generally tender with flatness to percussion in the flanks, the greatest tenderness being at the left lower quadrant. Rectal examination revealed a thick closed cervix. Extreme tenderness was elicited on palpation of the cervix. There was fullness in the cul-de-sac of Douglas and in both lateral vaults. The hemoglobin was 50 per cent, Sahli, red blood count 2,460,000, white blood count 30,300. A diagnosis of ruptured left tubal pregnancy with hemoperitoneum and early shock was made and preparations for operation started. While the patient was being typed and cross matched, 250 cc. of plasma were administered intravenously and this was followed by a continuous drip of 5 per cent glucose in saline. Arrangements were made for the sterile aspiration and collection of free blood from the abdominal cavity. A blood transfusion was started intravenously as the operation was begun. The blood pressure at this time was 90 systolic and 60 diastolic.

A laparotomy was performed. On opening the abdomen the peritoneal cavity was found filled with free and clotted blood; 550 cc. of

the free blood were aspirated into a sterile flask containing 100 cc. of sodium citrate solution. The clotted blood was removed. As the free blood was being aspirated, quick exploration of the pelvis revealed a rupture to be at the isthmus of the left tube and there was active bleeding. Left salpingo-oophorectomy was quickly performed and the bleeding controlled. At this time her blood pressure dropped to 80 systolic and 20 diastolic. The pulse was thready and weak with a rate of 130. The transfusion ceased running abruptly, the needle having been dislodged from the only available good vein. Attempts to find another suitable vein failed, therefore, an intrasternal transfusion was started below the angle of Louis and the blood allowed to run in rapidly. Fifteen minutes after the osteoclysis was started the blood pressure had risen to 95 systolic and 50 diastolic and the pulse had dropped to 100.

The patient was returned to her room and although she was extremely restless when coming out of the ether anesthesia, the needle remained firmly fixed in the sternum and the blood infused at the rate of sixty drops a minute. After the first 500 cc. of blood were allowed to run in, the 650 cc. of the patient's citrated blood which were obtained from the peritoneal cavity were inserted. This was followed by 1,500 cc. of 5 per cent glucose in saline and at 8 A.M. the following morning, the patient being in good condition, the intrasternal needle was removed. The hemoglobin at this time was found to be 45 per cent, Sahli, and the red blood count 2,150,000. Her postoperative course was entirely uneventful.

The microscopic report revealed a ruptured ectopic tubal pregnancy with chorionic villae, decidua and trophoblastic giant cells. She was discharged on the thirteenth day at which time her hemoglobin was 70 per cent, Sahli, with a red blood count of 3,680,000.

SUMMARY AND CONCLUSIONS

Intrasternal infusion is a life-saving procedure in severe obstetrical hemorrhage when the peripheral veins have collapsed. In less urgent cases it may be used routinely when the ordinary intravenous routes cannot, for any reason, be utilized.

The technic, indications, and necessary precautions are described.

Two cases, illustrating the value of the method, are presented.

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SIMPLIFIED PROCEDURE FOR THE TREATMENT OF IMPASSABLE URETHRAL STRICTURES AND RUPTURE OF THE URETHRA

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IMPASSABLE urethral stricture and rupture of the urethra, two separate entities, are considered together because they are alike in that with both there is (1) dissolution of continuity of the urethra, (2) there is retention of urine, and (3) the bulbomembranous urethra is usually the site of involvement. Because of these similarities the same general plan of treatment applies to both.

It is of practical importance to outline the management of these very serious conditions at the present time for several reasons. First, the student is taught little of practical value about their management in medical school; secondly, reference to text books and medical literature on the subject reveals a surprising lack of unanimity of opinion as to treatment. Writers are unanimous in stressing the gravity of these conditions, and rightly so, but they err in overemphasizing the difficulties and complexities of treatment in involved discussions which cannot help but leave the student in a state of utter bewilderment. The fact that so many different operative procedures are proposed for these conditions shows that the men who are doing them are not entirely satisfied with what they are doing. This is analogous to the medical treatment of disease in which the efficacy of treatment is in inverse ratio to the number of remedies proposed. As a matter of fact, their management is comparatively simple if a few simple principles of treatment are understood and followed. It is not outside the scope of the general practitioner to handle these problems successfully, and it is particularly important at the present time that he assume a useful rôle in their management because of the increasing number of urethral injuries resulting from the accelerated pace of industry and as a result of war wounds.

Let us start first with strictures of the urethra. Omitting congenital strictures, which are comparatively rare, we may divide strictures etiologically into two groups: (1) Inflammatory, of which the vast majority are of gonorrheal origin, and (2) traumatic, most commonly due to "straddle injuries," such as falling astride some hard object.

The majority of all strictures of the urethra are of gonorrheal origin. In the future we will probably see fewer because of the fact that the majority of cases of gonorrhea respond to the sulfa drugs. Prior to the advent of the sulfa drugs, gonorrheal urethritis was treated locally and often overtreated because of the tendency of the disease to become protracted and fail to respond to routine measures.

Overtreatment locally has been in the past a prolific source of strictures, so much so in fact that Keyes was prompted to say that the gonorrheal victim's best chance to get well was to keep the physician out of the urethra.

Traumatic strictures, as a rule, are more serious than inflammatory because they are more rigid, less resilient and less amenable to dilatation. Furthermore, traumatic strictures have an unfortunate habit for some unknown reason of causing impotence in a high percentage of cases.

Treatment. Most strictures, whether inflammatory or traumatic, are located in the deep urethra, that is, the bulbomembranous portion. The posterior urethra (the prostatic urethra) is not subject to strictures. It is in the bulbomembranous urethra that

we find almost exclusively those strictures which gradually reduce the urinary stream to a dribble and finally complete retention, and at this point they may be complicated by peri-urethral phlegmon and urinary extravasation. These complications, of course, require adequate surgical drainage. As a rule, most strictures can be successfully dilated with sounds, or with filiforms and followers. If they do not yield to this treatment, it may be necessary to cut them from within (internal urethrotomy), using a urethrotome. If filiforms and followers cannot be passed to the bladder permitting internal urethrotomy, then the following simple procedure is indicated:

The patient is prepared for suprapubic and perineal surgery. Under low spinal anesthesia, with the patient in lithotomy position, a suprapubic cystotomy is done. The opening need be large enough only to admit the index finger. The Davis interlocking sounds[1] are now brought into play. The male sound is passed through the anterior urethra as far as possible. The female sound is then guided into the posterior urethra through the suprapubic wound. By gentle manipulation the two sounds are brought together (Fig. 1), the male following the female up into the bladder. A Robinson double eye catheter, No. 20 to 24 F., is tied to the male sound (Fig. 2) which is withdrawn, pulling the catheter with it. This re-establishes the continuity of the urethra and the catheter is left in place as a retention catheter for seven to ten days before being withdrawn. This permits the suprapubic cystotomy wound to heal and maintains the patency of the urethra. After the catheter is with-

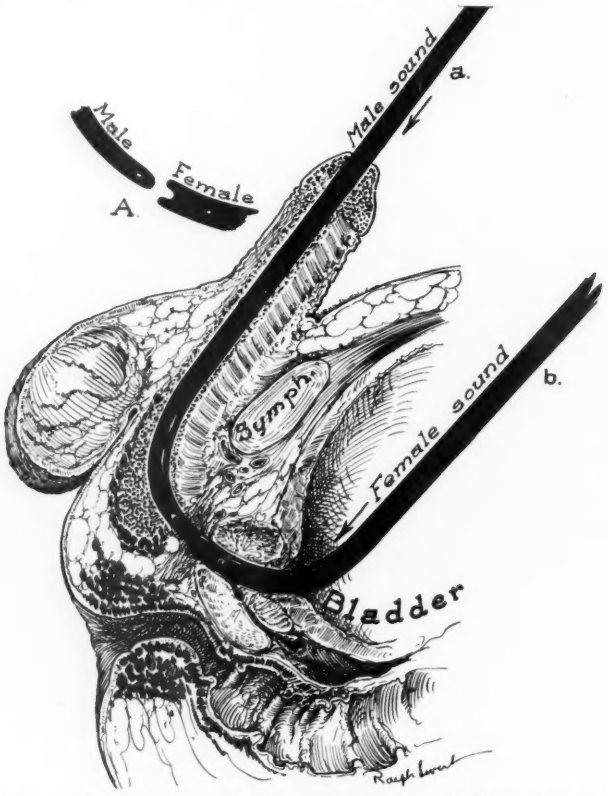

Fig. 1. Drawing to illustrate Davis interlocking sound technic applicable alike to impassable urethral stricture, and to rupture of the urethra. The male sound (*a*) passed per urethram contacts the female sound (*b*) introduced into the prostatic urethra through a cystotomy wound. When the two sounds are approximated the male then follows the female into the bladder without difficulty.

drawn the urethra is dilated with sounds first at weekly intervals then at lengthening intervals depending upon the patency and caliber of the strictured area. The aphorism that a stricture is never cured is a true one, so that the passage of sounds may be required at intervals for an indefinite period.

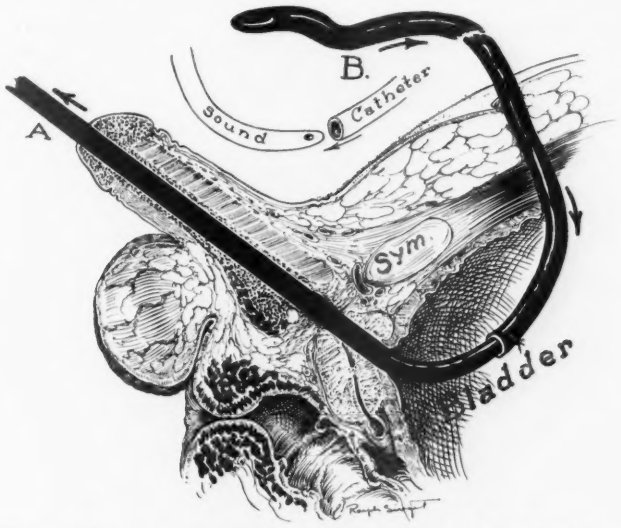

Fig. 2. Drawing showing end of male sound (A) in bladder. Female sound has been withdrawn and a catheter (B) is anchored to the male sound. The male sound is then withdrawn, pulling the catheter out through the urethra where it is left in place as a retention catheter for permanent drainage of the bladder peruret hram. The cystotomy wound is allowed to close. After one to two weeks the urethral catheter is removed, and the patency of the restored urethra maintained by passage of occasional sounds.

In the event that the Davis interlocking sounds cannot be brought together because of the density and extent of an unyielding stricture, it is a simple matter since the patient is in lithotomy position, to palpate the ends of the two sounds in the perineum and to excise through a small midline perineal incision the scar tissue which prevents union of the sounds. (Fig. 3.) This may comprise an area 1 to 3 cm. in extent. Then the Davis interlocking sounds are brought together and the operation completed as outlined above.

Some authors make much of the necessity of approximating by suture the urethral mucous membrane of the distal and proximal segments after excision of the stricture. In my experience, this is a woeful and unnecessary waste of time and suture material. Nature has fortunately endowed the urethra with wonderful powers of recuperation. With a retention catheter in place acting as a splint the urethral mucous membrane will regenerate rapidly over a wide area, so that after a period of one to two weeks the urethral catheter may be safely removed and one will be rewarded with an intact patent urethra. Of course, one cannot wholly escape reformation of a certain amount of scar tissue so that occasional passage of sounds may be necessary as follow-up treatment.

The above described procedure accomplished with the aid of the Davis interlocking sounds is surprisingly easy to perform, and can be accomplished very quickly with a minimum of damage to normal structures. This is in direct contrast to the type of external urethrotomy advised by many authors, consisting of a difficult perineal dissection without resorting to the use of suprapubic cystotomy and the Davis interlocking sounds. No operation can be more difficult, and damage to the external sphincter or even the rectum

may result from floundering around in the perineum in the midst of a mass of scar tissue where normal landmarks are hopelessly distorted or lost, vainly seeking to identify and approximate the normal proximal and distal urethral segments. This statement holds for operations for rupture of the urethra as well as stricture of the urethra. A case in point is one recently seen by the author in which the patient had a previous unsuccessful external urethrotomy operation for impassable stricture and was condemned to permanent cystotomy drainage. The continuity of the urethra was very easily restored with the Davis interlocking sound technic and the suprapubic fistula eliminated.

Rupture of the urethra is included in this dissertation because the treatment is exactly the same, namely, a preliminary suprapubic cystotomy followed by the use of the Davis interlocking sounds. As previously stated, trauma to the urethra is usually in the bulbomembranous area. The most common trauma is a "straddle injury" or a blow in the perineum. If the injury is mild, the urethra may not be actually ruptured but only bruised, so that the patient may still be able to urinate; but after a year or so the patient will develop complete retention as a late result

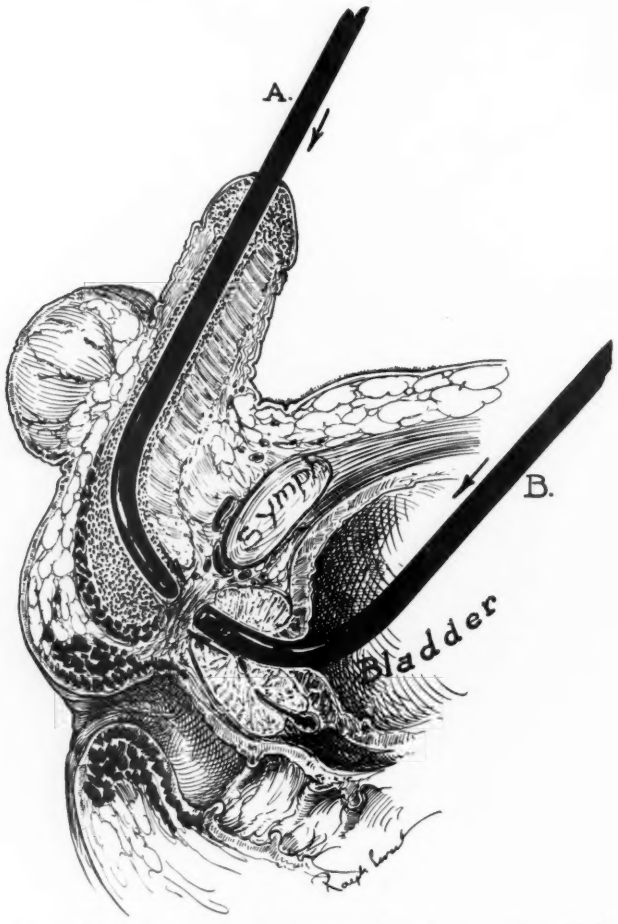

Fig. 3. Drawing to illustrate procedure in cases in which ends of sounds cannot be approximated. With the patient in extreme lithotomy position and sounds held in place by an assistant, it is easy to palpate their ends through the perineum and to excise the intervening scar tissue through a small midline incision. The sounds are then interlocked and the operation completed as described.

of the inevitable scar tissue formation which is bound to occur if the injury is of sufficient severity. As stated above, the management of traumatic stricture is exactly the same as for inflammatory stricture. Furthermore, if the injury is severe enough actually to rupture the urethra, the treatment again is exactly the same, namely, suprapubic cystotomy and the use of the Davis interlocking sounds. In the event of extravasation either of urine or blood or both, perineal incision is essential and more extensive incisions may be required for drainage if the extravasation is widespread.

Various authors quote mortality statistics as high as 40 or 50 per cent as a result of urinary extravasation incidental to rupture of the urethra and stricture of the urethra complicated by peri-urethral phlegmon and urinary extravasation. Prompt treatment as above outlined and the free use of the sulfa drugs locally and generally should greatly reduce this mortality rate. If a patient is in extremis when first seen, a two-stage operation may be necessary. This consists first of all in establishing suprapubic drainage, and multiple incision drainage of areas involved in extravasation. Since most strictures and injuries involve the bulbomembranous area, the extravasation will follow certain well defined planes conforming to Colles' fascia which confines it to the perineum and subcutaneous tissues of the scrotum. It may extend further up on to the abdomen as high as the axillae, since Colles' fascia is continuous with Scarpa's fascia. After one or two weeks the second stage may be accomplished quickly and easily with the Davis interlocking sound technic. As a typical example, I cite the case of a patient who had a stricture of the bulbomembranous urethra of some years standing. He subsequently suffered a blow to his perineum occasioned by the bumper of a truck. This resulted in complete retention and extravasation limited to the perineum and scrotum. He did not seek immediate medical aid and when first seen at the hospital he was semi-comotose and was having frequent clonic convulsions. The bladder was drained suprapubically and the extravasated area drained. The prognosis at this point was very poor, but in a few days he rallied and two weeks after entry the second stage consisting of the Davis interlocking sound technic was consummated. He made a complete recovery, and at the present time his urethra readily accommodates a No. 28 F. sound without resistance.

The degree of associated infection is an important factor in mortality, especially in strictures in which peri-urethral phlegmon may be the precurser of urinary extravasation with anaerobic invasion of the tissues. Toxic absorption is extremely rapid and such cases require prompt treatment to save life.

Traumatic rupture of the urethra or even the bladder is not apt to be so rapidly fatal because the urine is often sterile. Sterile urine is not toxic or harmful to the tissues. As an example of this I cite the case of a man who came home intoxicated and fell over the foot of his bed rupturing a full bladder. He was brought to the hospital the next day and I was first called to see him that night. He had a board-like abdomen but no fever. Intravenous urography was negative. Cystoscopy revealed a large intraperitoneal tear in the fundus of the bladder with a loop of small intestine protruding through it. Immediate suprapubic cystotomy was performed and the rent sutured. The peritoneal cavity was opened and approximately 4,000 cc. of clear urine withdrawn. He promptly healed per primam with no febrile reaction. Although he was not operated upon until at least thirty-six hours after his injury, the peritoneum and intestines showed no redness or reaction of any sort as a result of having a belly full of urine.

Gross injuries of the lower urinary tract often complicate fractures of the pelvis and may constitute problems of great gravity. The bulbomembranous urethra may be ruptured but more commonly the

bladder is ruptured by force of the impact or torn by a spicule of bone. An extreme case of this nature was a man whose pelvis was crushed by a steam shovel. The bladder and prostate were completely torn away from the urethra and were floating free in the lower abdomen. This problem was handled by doing a cystotomy and inserting a Pilcher bag, the end of which was brought out through the urethra with the aid of the Davis interlocking sounds. The bag was distended and traction applied. This moored the bladder and prostate back in their normal positions and reestablished the continuity of the urethra. An excellent ultimate functional result was obtained.

CONCLUSION

A simplified procedure for the treatment of impassable urethral stricture and rupture of the urethra is described which practical experience has shown to be highly successful. The same fundamental principles of treatment characterized by simplicity and ease of performance are applicable to both conditions. These remarks may be interpreted as a testimonial to the Davis interlocking sounds, and rightly so, because they have brought order out of chaos and make it possible for the general practitioner as well as the specialist to manage these hitherto difficult cases with greater ease and success, with a consequent reduction in morbidity and mortality rates. Utilization of this procedure deserves emphasis at the present time because of the rising tide of industrial and war injuries.

REFERENCE

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TWO-STAGE MAMMAPLASTY IN RELATION TO BLOOD SUPPLY

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ONE of the chief potential dangers in mammaplasty is interference with the blood supply. The breast is a highly vascular organ and its surgical reconstruction usually demands the formation of skin flaps and glandular pedicles, during which process some vessels are likely to be severed. Unless adequate vascularization is preserved, necrosis of the skin and glandular structures will occur. A clear understanding of the vascular distribution is essential to prevent this.

Unfortunately many inaccuracies have crept into the literature on this subject: the classical description of the old anatomists errs on many points and most of the modern authors until a few years ago, including the writer, accepted these faulty data.[1] Since the use of roentgenographic studies of injected vessels, however, a more complete and accurate picture is available. The chief difference lies in the larger rôle attributed to the thoracic lateral artery in mammary vascularization.

The writer has elsewhere described fully the arterial blood supply of the breast as revealed by recent investigations.[2] This paper will discuss the author's two-stage procedure in relation to some of the salient features of mammary vascularization.

MAIN SOURCES OF VASCULARIZATION*

The blood supply of the breast has three main sources. (Fig. 1.) (1) The internal mammary artery, originating from the subclavian; (2) the thoracic lateral, branch of the external mammary artery; (3) the intercostal arteries, originating from the aorta, (of secondary importance).

The degree in which these different vessels participate in the vascularization of the breast varies with the individual, but there are always at least two main sources. The most frequent combinations are: (1) The internal mammary artery and the thoracic lateral artery (50 per cent of cases); (2) the internal mammary artery and the intercostal arteries (30 per cent). (3) the internal mammary artery, the thoracic lateral artery and the intercostals (about 18 per cent).

The internal mammary artery is the main artery of the breast and usually sends out two types of ramifications, anterior and posterior perforating branches (i.e., with respect to the gland). The distribution and location of the anterior perforating branches of the internal mammary are of definite practical importance in mammaplasty. (Fig. 2.) According to recent studies, the inner intercostals on the posterior aspect of the gland derive from the internal mammary artery and not from the aorta, as was long supposed.[3] Their disposition and origin make posterior resection of the gland the safest one, as it does not disturb the main anterior vascular pedicles. (Fig. 2.)

The Thoracic Lateral Artery. The majority of anatomists agree on the predominance of the internal mammary artery in the vascularization of the breast. Recent investigations prove beyond doubt that the thoracic lateral artery also participates largely in mammary vascularization. In fact, some investigators consider its participation in the vascularization of the gland and nipple universal, though others limit it to about 55 per cent of cases.[2]

It is important to note that in about 13 per cent of cases, the thoracic lateral artery plays a predominant part in the vascularization of the gland. Consequently, its sacrifice through excision of the lateral

* Only arteries are described here as the veins usually follow a similar course.

half of the breast* may result in necrosis of the central part of the gland, including the nipple. (Figs. 3 and 8.)

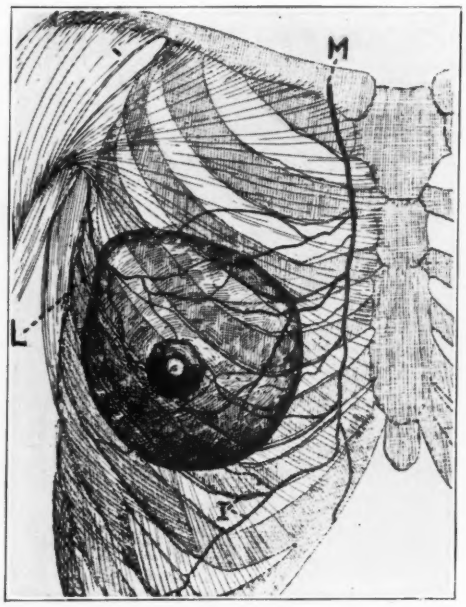


Fig. 1. Main vascular pedicles of the breast, according to the present day concept of its blood supply (diagrammatic). Note the numerous anastomotic branches above and below the nipple. The deeply located ramifications are represented by dotted lines. L, the thoracic lateral artery and its two main ramifications on the external aspect of the gland; M, internal mammary artery with its perforating anterior branches; I, intercostal arteries.

PERIAREOLAR VASCULAR TOPOGRAPHY

The nipple and the central parts of the gland are particularly subject to necrosis in certain reparative procedures. In approaching the nipple, branches of the main arterial pedicles form two anastomotic plexuses, one superficial, the other in the depth of the gland. Roentgenographic studies of injected vessels of the breast reveal the following main types:

1. The *circular* periareolar plexus, in which ramifications of the main vascular pedicles form almost a complete ring around the nipple. This variety found in about 70 to 74 per cent of cases, assures maximum blood supply and can be considered the safest from the viewpoint of possible necrosis. In the presence of a circular anastomosis, semi-circular resection of the breast will not compromise the vitality of the nipple. (Fig. 4.)

Fig. 2. Vascular topography on posterior aspect of breast. The intercostal arteries are long and penetrate the gland by short ramifications; this permits their easy retraction in the posterior approach of the gland. Note that the inner intercostal arteries, IM, originate from the internal mammary artery, (M); I, intercostal arteries (aorta) of secondary importance; L, thoracic lateral artery.

2. The *loop type* plexus has been observed in about 20 per cent of breasts examined.[2] Here the thoracic lateral artery predominates and resection of the internal half of the gland in a mammaplasty is usually safe. The formation of an internal glandular pedicle, on the other hand, may result in necrosis of the nipple by reducing the blood supply of that area to a dangerous degree.

3. The *radial type* plexus is characterized by the lack of any ring or loop formation around the nipple. (Fig. 5.) The branches from the two main sources are directed toward the nipple at a distance from each other, without anastomosis between them and their main arterial pedicles. This type is found in about 6 per cent of cases. Here deep lateral glandular excision in the areolar zone will necessarily sever the main source of blood supply to the corresponding

* Biesenberger's method of mammaplasty.

part of the breast and almost invariably produce necrosis of the nipple for lack of anastomotic compensation.

included to avoid injury to the main vascular branches located subcutaneously.

3. Excision of the internal half of the

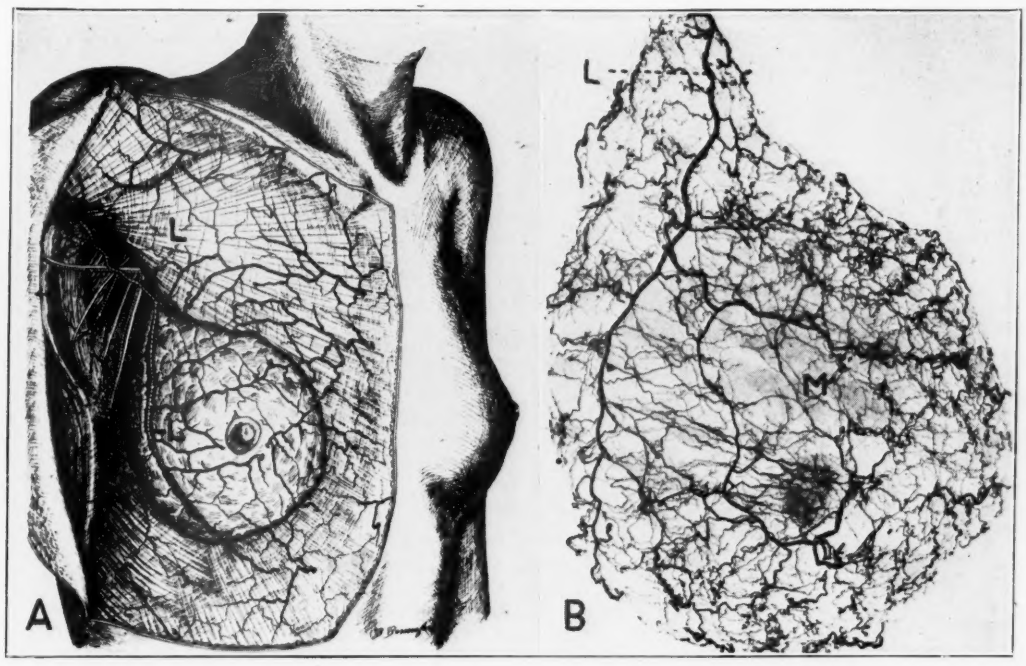


Fig. 3. A, thoracic lateral artery and its topography. Two main branches (L) follow the external aspect of the gland. Note the numerous anastomoses above and below the nipple with the branches of the internal mammary artery. B, thoracic lateral artery, a frequent variety of overdevelopment. Injected right breast of a woman of twenty-two, deprived of cutaneous covering (Salmon). The thoracic lateral artery (L) is here well developed and supplies more than half of the gland. The main perforating branch of the internal mammary artery (M) is small. Resection of the external half of the breast in the course of a mammaplasty in this case could sufficiently disturb the blood supply of the central zone of the gland and nipple to bring about their necrosis. In about 13 per cent of cases, the thoracic lateral artery plays a predominant part in vascularization of the breast.

As it is impossible, prior to surgery, to foretell which type of vascularization will be encountered, all eventualities must be kept in mind in appraising a surgical procedure.

STEPS FOR PRESERVATION OF BLOOD SUPPLY IN SKIN AND GLANDULAR PEDICLES

On the basis of revised anatomical data,[2] the following precautions must be observed for the preservation of blood supply in skin and glandular pedicles:

1. Incisions made in the periareolar area must be superficial, with intradermic resection of the areolar skin.

2. In the preparation of skin flaps, adequate subcutaneous tissue must be

breast should be avoided because of the fact that the internal mammary artery is the main artery to the gland.

4. Resection of the external half of the breast is also contraindicated because of the danger of interference with the important vascularization supplied by the thoracic lateral artery. Gillies and McIndoe,[4] who describe the use of an internal glandular pedicle following resection of the outer half of the breast by a method similar to Biesenberger's, report local complications in 22.5 per cent of a series of eighty cases. The writer abandoned a similar method many years ago after encountering partial and total unilateral necrosis of the nipple in four out of twenty-three cases in which the external half of

the breast had been resected. The fact that the necrosis occurred on one side only confirms the presence of vascular asymmetry, as identical procedures were carried out on both breasts.

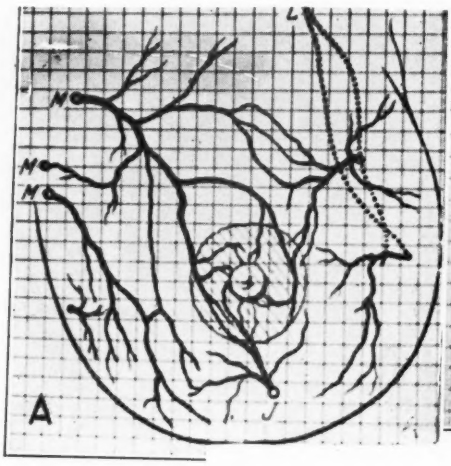


Fig. 4.

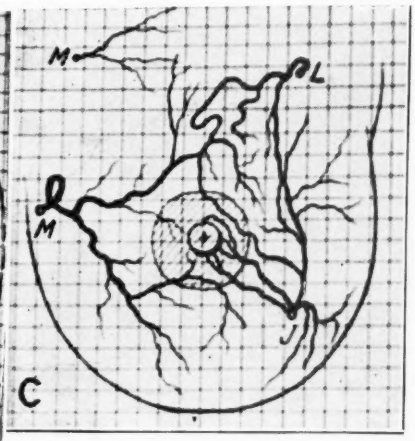


Fig. 5.

Fig. 4. A, the branches of the main arterial pedicles form a complete ring around the nipple. This is the safest type of vascularization from the viewpoint of possible necrosis. It is found in about 70 to 74 per cent of cases. J, intercostal artery; L, thoracic lateral artery; M, internal mammary artery.

Fig. 5. C, radial type of periareolar plexus characterized by the lack of anastomotic formations between the branches of the main arteries directed toward the nipple. This arterial disposition was found in 6 per cent of injected vessels of the breast. In such instances an extensive resection of the gland done simultaneously with a circular incision around the nipple will in all probability be followed by its necrosis. Because of this danger, all one-stage mammaplasties based on extensive resection of the gland should be condemned. M, internal mammary artery; L, thoracic lateral artery; J, intercostal arteries.

5. If excision of glandular tissue is necessary, it is best done in the "safety zones" of the gland, namely, in the midline between the main vascular pedicles (upper quadrants) and in the external lower quadrant. (Fig. 6.)

The following two-stage procedure conforms to the principles enumerated above and embodies maximum safety factors.

UNDERLYING PRINCIPLE OF THE TWO-STAGE PROCEDURE

Surgical reconstruction of the breast should be done in two stages to permit safe transposition of its central portion prior to any extensive resection of the skin and glandular structures which might interfere with the blood supply. If wide excision of breast tissue is made simultaneously with transposition of the central part of the gland and nipple, interference with the vascular system is likely to occur. (Fig. 8.)

It has been proved, as stated above, that there is lack of uniformity in the vascularization of the breast and that reliance on the predominance of one vascular pedicle over another is dependent on guesswork. Although the internal mammary is the predominant artery in the majority of cases, the thoracic lateral artery may predominate in a certain percentage. When large sections of breast tissue are excised, there is risk of excessive diminution of the blood supply of the remaining gland with consequent necrosis of the part. Our inability to foresee the actual distribution of the blood supply in any one case necessarily dictates caution in all. (Fig. 3.)

In the two-stage operation, the transposition of the central portion of the breast is done first with no disturbance of the blood supply. Six to eight weeks later, excess glandular tissue can be removed with complete safety. Division of the

surgery into two stages not only eliminates all danger of necrosis, but contributes to a more esthetic end result, since the final re-adjustment of shape and form can be done without haste during the second stage. An additional advantage is the lessening of operative shock.

The writer has employed this two-stage procedure since 1929 with few modifications.[6] In 193 cases, total necrosis of the nipple has never been encountered. In our early experiences, localized skin sloughs occurred mostly along the edges of the flaps and around the nipple, as a result of making the skin flaps too thin or suturing them under undue tension. Since the employment of thicker flaps, no skin necrosis of any extent has taken place.

Preoperative Preparation. The general condition of the patient should be thoroughly checked and surgery done only if the individual is physically and mentally fit. The skin must be carefully prepared especially in the submammary region, which is frequently the seat of irritation caused by excessive perspiration. General anesthesia is administered routinely.

Preoperative Markings. Many methods have been described for proper location of the transposed nipples. The author draws vertical and horizontal lines, respectively, through the middle of the clavicle and the upper arm; their intersection approximately determines the position of the nipple. Many other factors must also be taken into consideration, such as the size of the chest, the height of the individual, etc. An artistic appreciation of the region is probably still the best guide for tracing the landmarks.

One of the most common mistakes with regard to the new location of the nipples is a tendency to place them asymmetrically too high or too near the sternum. The size of the buttonhole necessarily depends on the size of the transposed areola. An excessively large areola must often be reduced prior to transposition and the buttonhole outlined accordingly. To avoid excessive tension on the nipple, an allowance of 2 to 3 mm. in the diameter of the new implacement is made.

OPERATIVE PROCEDURE*

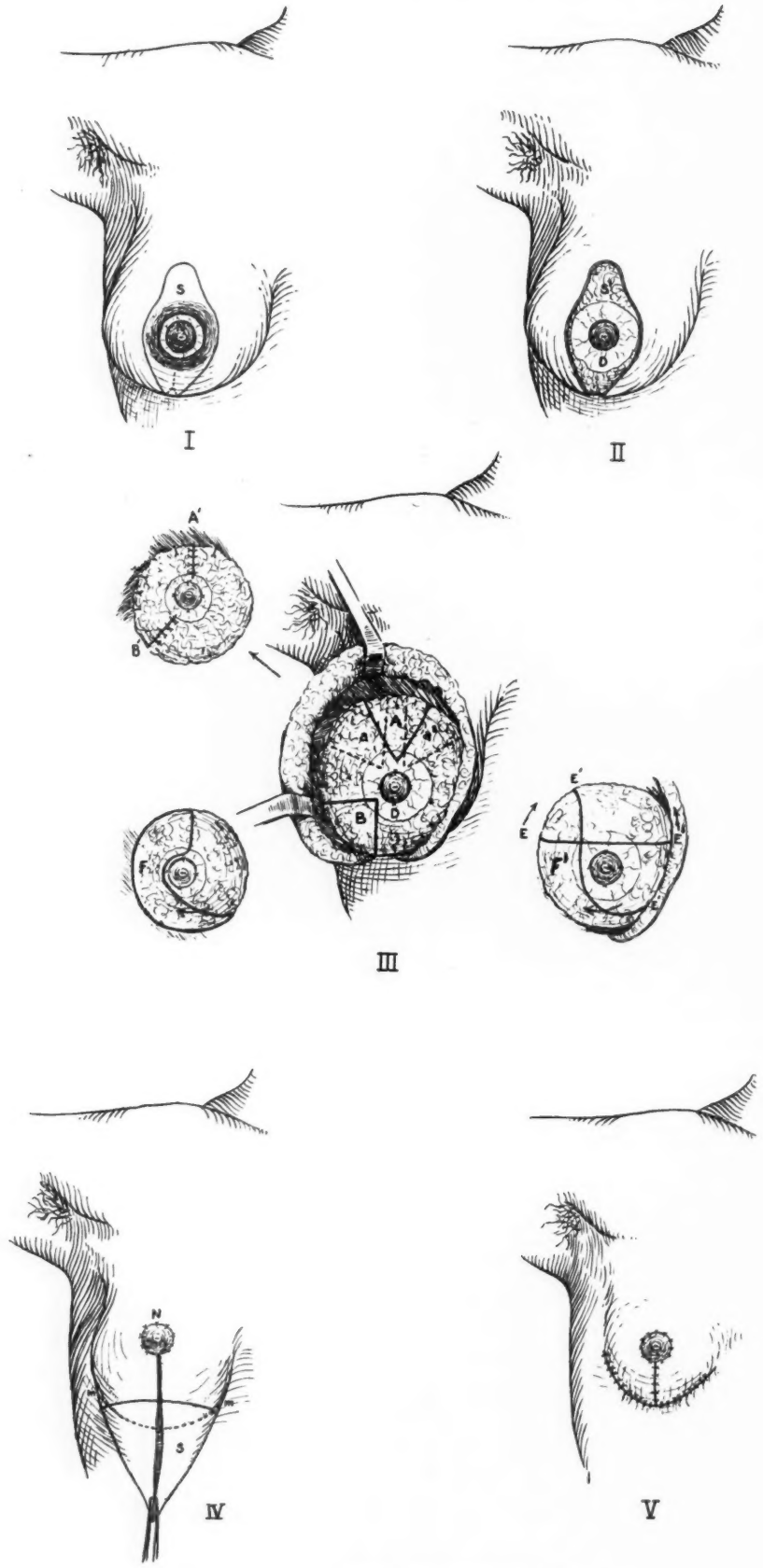
1. A *periareolar incision* is so made as to outline a normally shaped areola of circular form. The size of the outlined areola varies according to the individual. Generally the pigmented area in hypertrophied breasts is much too large and requires reduction. (Fig. 6.)

Dissection of the fine areolar skin is done superficially to preserve the arterial and venous plexuses located in close contact with the derm; it is carried out intradermally, avoiding the subcutaneous layer. Injury to the vascular plexus during this stage must be followed by thorough hemostasis to prevent the formation of hematoma.

Traumatization of the nipple by rough handling with instruments must be avoided. Following the circular incision, the retracted areolar skin is temporarily affixed to the deep structures at the ends of the horizontal and vertical diameters to prevent its separation on handling the gland.

2. *Preparation of Skin Flaps.* For the upper skin flaps, which the writer uses in most of the marked hypertrophies, a horizontal incision is made directly above the areolar zone, with a slight concavity directed upward. It must be ascertained from the beginning that the outlined subareolar skin is of sufficient height to permit its suturing in the submammary fold in the second stage. In moderate ptosis this is impossible as the buttonhole is made low and the horizontal suture line must, therefore, be placed above the submammary fold. That is one of the reasons why the double flap is preferable to the single upper flap in the repair of medium sized hypertrophies and simple ptosis. (Figs. 6 and 7.)

* A detailed description has been published elsewhere;[6] this paper stresses modifications of technic developed since.



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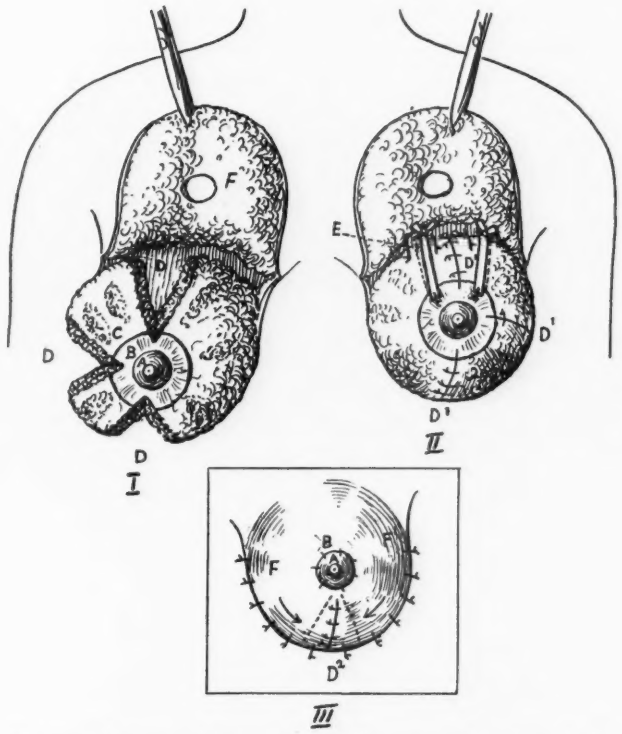
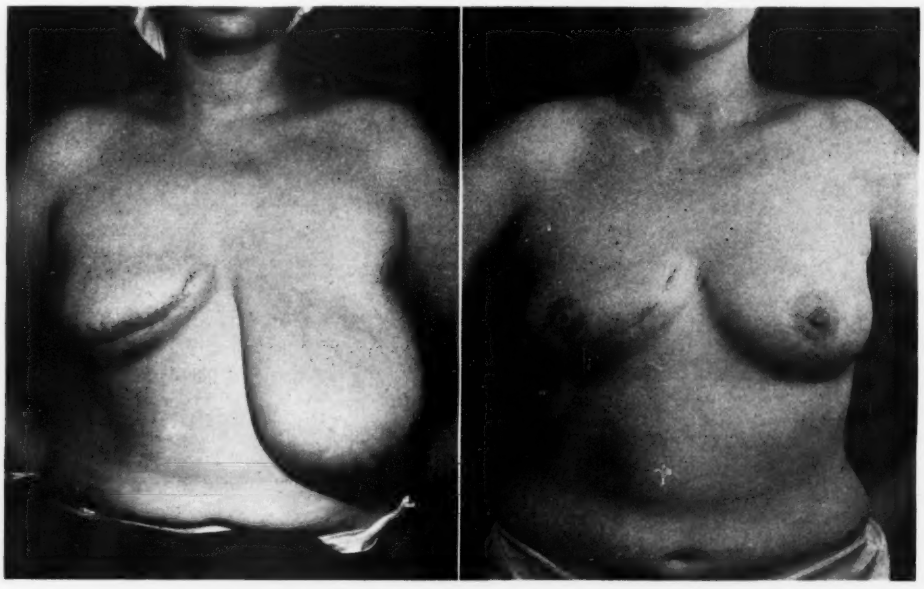


FIG. 7. Mammaplasty showing fenestrated upper horizontal flap with safe wedge-shaped mammary excisions. I, B, periareolar derm left attached to the gland to preserve the central vascular plexuses; D, safe wedge-shaped glandular excision; F, fenestrated horizontal flap with attached subcutaneous tissue. II, suspension and affixation of the reduced gland. D^1, closure of glandular defects; E, dermal loops obtained from discarded mammary skin after removal of epidermis. These loops extending from the dermal disc to the pectoral fascia assure good affixation of the ptosed gland. III, reduction of horizontal diameter of breast; F, F^1, in second stage by midline excision, D^2.

FIG. 6. Open transposition of central mammary segment with midline resection of skin flaps. Procedure especially indicated for ptosed breasts of medium sized hypertrophy, requiring good affixation. I, midline skin excision (S) with formation of two lateral flaps. Areola reduced in size leaving nipple (N) firmly attached to periareolar derm. II, S^1, central skin defect. Lateral flaps are bluntly undermined to expose the gland to the second intercostal space. D, periareolar plexus left intact together with a dermal zone following superficial excision of areolar skin. III, safe and dangerous glandular resections. A, B, safe wedge-shaped resections in the upper and lower lateral quadrants avoiding injury to the main vascular pedicles of the thoracic lateral artery and internal mammary artery. A^1, B^1, closure of glandular defects and affixation to the pectoral fascia. *a*, a^1, unsafe wedge-shaped resections in the areas of the main vascular pedicles of the gland. (See Fig. 7.) E, E^1, resection of upper half of the gland, unsafe for the same reason as above. F, external resection of gland with upward rotation of an internal pedicle (Gillies, McIndoe). F^1, extent of external resection in procedure of Biesenberger. These procedures are contraindicated because of sacrifice of the blood supply reaching the nipple from the thoracic lateral artery, which often is the main artery of the gland; necrosis of the nipple sometimes follows these methods. IV, N, nipple sutured in upper pole of skin defect; *m*, *m*, full and dotted lines along which the lateral flaps are excised. V, final reversed T-shaped suture line.

Although the incision of the flap must be long enough to permit free exposure of the anterior aspect of the breast, it is advisable not to extend same toward the midline or far into the axilla in order to prevent excessive scarring. Wide excision of skin from the posterior aspect of the breast is avoided during the first stage to eliminate any disturbances in vascularization of the nipple through undue tension.



A B

Fig. 8. A, necrosis of right breast in girl aged twenty-two following one-stage mammaplasty for fatty hypertrophy, done elsewhere. Right breast prior to surgery had been similar to left shown here. The excision of the external half of the gland simultaneously with transposition of nipple sufficiently disrupted the blood supply to bring about sloughing of the central part of the breast. B, a two-stage mammaplasty was done by me on the left breast: transposition of its central segment in a buttonhole of an upper horizontal flap in first stage with final shaping of mammary structures in a second stage. Wedge-shaped glandular excisions were made in midline between the two upper quadrants and from the lower external quadrant. Scar excision and tattooing of nipple on right breast.

The single horizontal skin flap has definite advantages over the double flap with regard to blood supply. At first I prepared this flap rather thin on the assumption that the anterior blood supply would be preserved by leaving the subcutaneous fat attached to the gland. However, experience demonstrated that, in view of its length, this flap must be thick enough to retain the cutaneous branches of the vascular pedicles. Since their depth is approximately 1 to 1½ cm., this should be the minimum thickness of the flaps. To avoid injury to the main branches arising from the two pedicles, particularly the internal mammary artery) the dissection of the flap is done bluntly with a gauze sponge. The use of sharp instruments should under all circumstances be avoided as it entails needless bleeding. The undermining of the upper flap extends to the second intercostal space, where the affixation of the upper pole of the gland is done. (Fig. 7.)

As a rule the shape of the breast should be outlined by the glandular structures and not by an excessively stretched skin, which is unsuitable for the maintenance of the mammary contour and is likely to give way under moderate weight or pressure. Recurrences following mammaplasty will be prevented by not placing too much reliance on the skin as a means of maintaining the mammary structures. The necessary reduction of the gland itself and its adequate affixation to the pectoral

fascia are the only means to obtain and insure the proper shape of the breast; the skin should merely provide an evenly distributed covering for the reconstructed parts.

A disadvantage in the use of the single horizontal flap is the resulting excessive width of the breast. This is remedied in the second stage by excision of excess skin in the midline and along the submammary fold simultaneously with a wedge-shaped glandular excision from the lower external quadrant. (Figs. 9 and 10.)

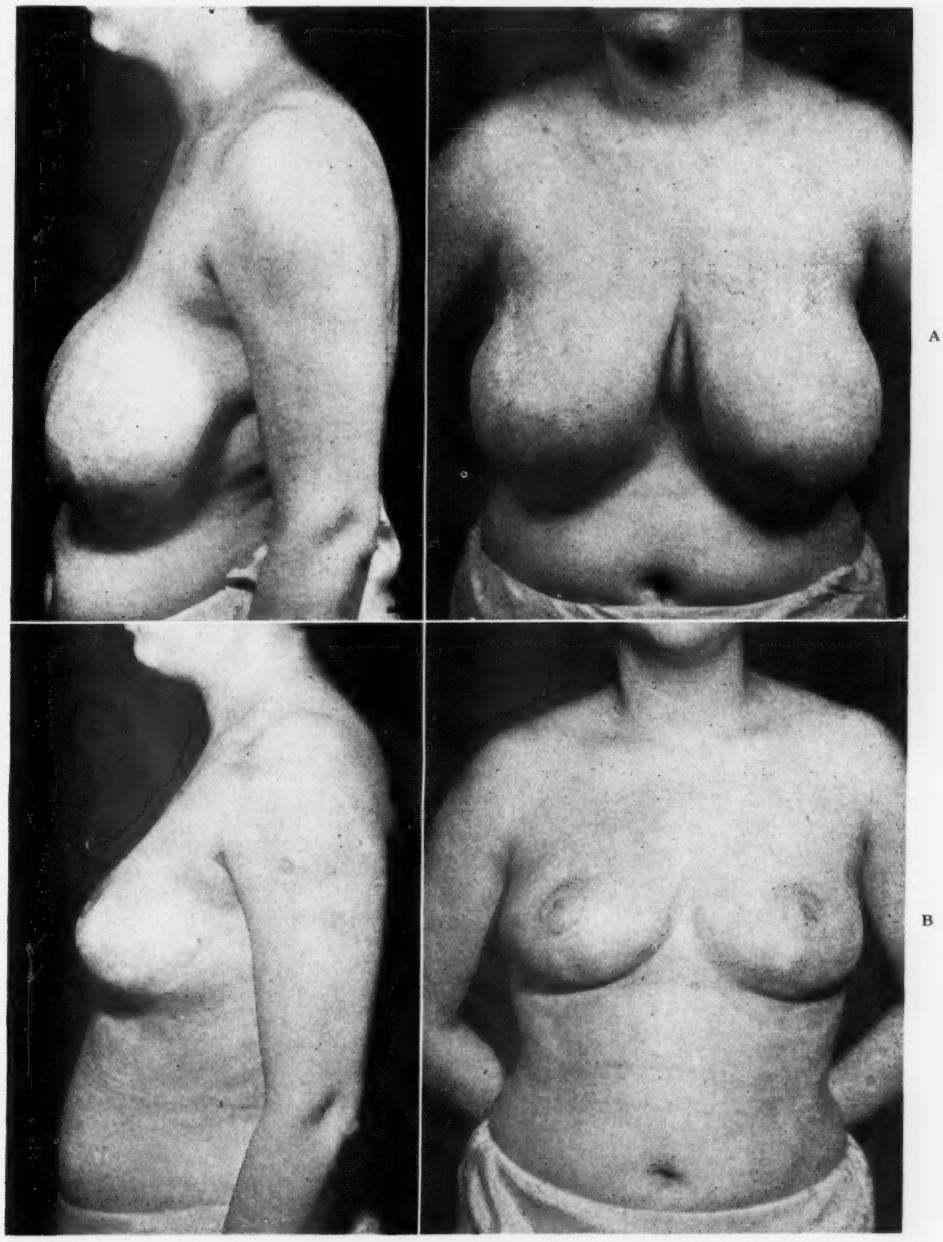
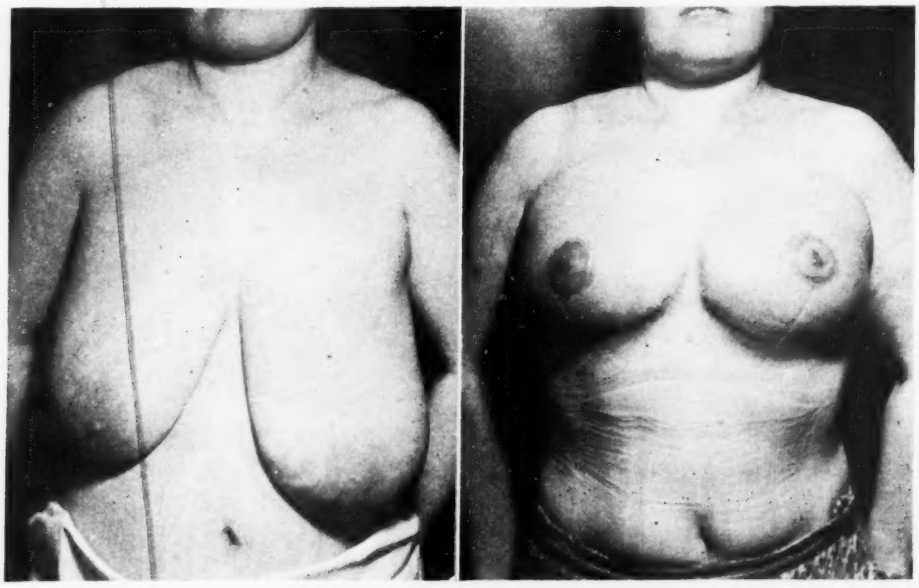


Fig. 9. A, marked hypertrophy and ptosis in a girl aged twenty-four, overweight, but without history of glandular disturbance. Note distended venous plexus visible under thin skin and also the faulty posture due to the weight of the breast. B, mammaplasty in two stages with glandular wedge excision between upper quadrants done in first stage and excess skin and gland resection in midline of lower quadrants in second stage.

The double skin flap is indicated in moderate ptosis repaired in a single-stage procedure. Its preparation is based on the

same principles as govern the outlining of the upper single flap. To bring about an even distribution of the skin covering over the affixed gland, it is necessary to undermine the two lateral flaps widely, through a vertical incision extending from the nipple toward the submammary fold. The extent of the horizontal skin excision in the submammary fold will depend on individual requirements. The resulting scar will be an inverted "T." (Fig. 6.) It should be kept in mind that, in the open transposition of the central part of the gland, the blood supply of the flaps is reduced by the midline incision. When they are made thin and sutured under tension in a single-stage procedure, superficial sloughing of the skin along the edges is liable to occur. This is particularly true when glandular excision from the lower quadrants is carried out at the same stage and the two suture lines are superimposed. This can be partly avoided by excision of a glandular wedge from the lateral quadrant rather than in midline. (Figs. 6 and 11.)



A B

Fig. 10. A, asymmetrical hypertrophic breasts with mastitis in a woman, aged thirty-seven. Rapid growth of both breasts followed two pregnancies. The patient being of rather small stature, complained mainly about the weight of the breasts which caused pain in the shoulders and faulty posture. Numerous nodules were felt in both breasts, some the size of an egg. Two large masses were present in the external quadrant of the left breast extending from the center toward the axilla. B, following a two-stage mammaplasty. In the first stage simultaneously with transposition of the nipple in a buttonhole of a horizontal skin flap, two cystic fibromas weighing 690 Gm. were removed from the left breast and numerous nodules of smaller size from the right one. Histology revealed marked hyperplasia of the ducts and hypertrophy of the breast acini. Patient seen eight years after surgery presents well maintained breasts without recurrence of fibromas.

3. *Glandular Pedicles.* In large hypertrophies, if necessary, a wedge-shaped excision can be made in the first stage in the central segment of the upper half of the gland. This entails small jeopardy to the two main vascular pedicles. (Fig. 6.) The resulting glandular defect is closed with plain catgut and the gland itself affixed to the pectoral fascia, preferably with dermal loops. Any further reduction in the size of the gland during the first stage is inadvisable. (Fig. 7.)

The final reduction of glandular structures is carried out at the second stage, when any amount of breast tissue can be removed with safety after the "take" of the transposed central segment.

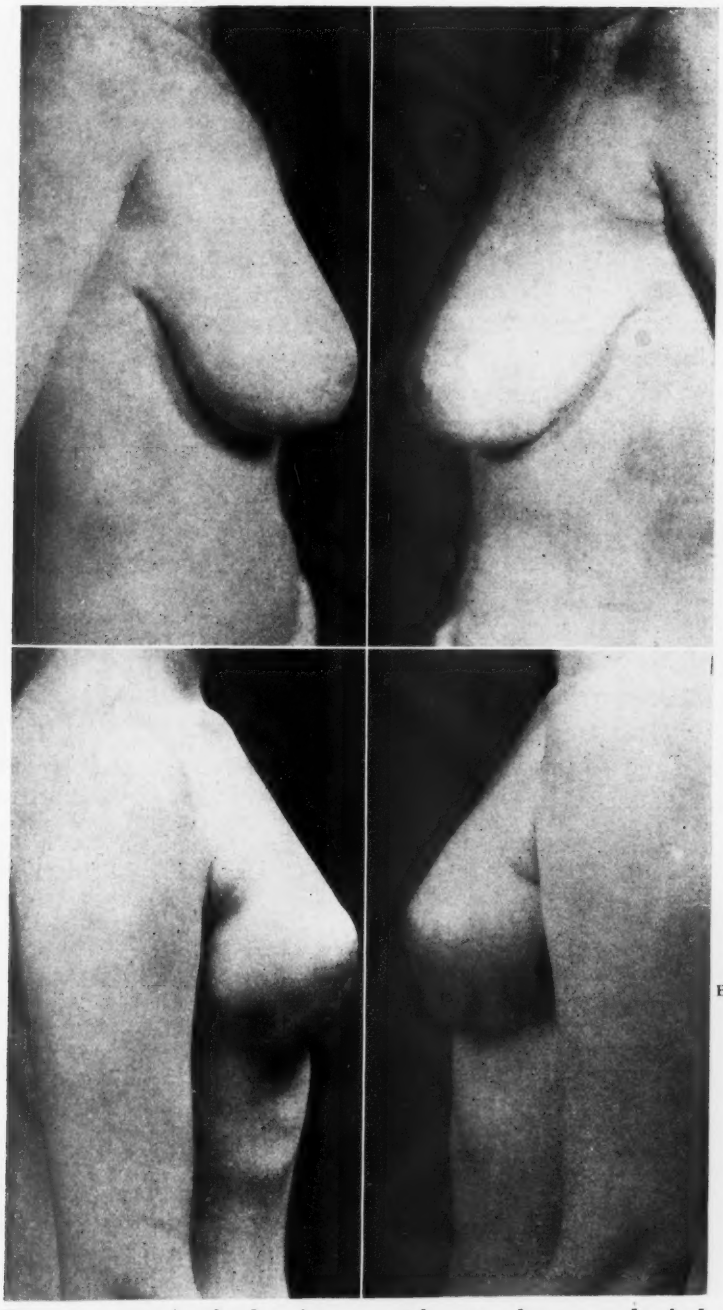


Fig. 11. A, ptosis of otherwise normal breasts, due to mechanical pressure of tight brassieres in a girl of twenty. The deformity was brought about by a desire to hide the breast protrusion, the patient being a dancer. B, mammaplasty by open transposition of the central part of the gland in one stage. The two lateral flaps were sutured in midline and along submammary fold leaving a reversed T scar. Because of the weakness and distention of the suspensory apparatus in these cases, a thorough mastopexy to the pectoral fascia with dermal loops is indicated. (See Fig. 7.)

In hypertrophies with excessive protrusion, a discoid resection from the posterior aspect of the breast can be done.[7]

SUMMARY AND CONCLUSIONS

1. The blood supply of the breast is provided by three main sources: the internal mammary artery, the thoracic lateral artery and the intercostals. The safety of mammaplasty depends on the preservation of adequate vascularization.

2. In approximately 55 per cent of cases, the thoracic lateral artery has an equal part, and in 13 per cent a predominant part, in vascularization of the gland. Failure to respect the rôle of the thoracic lateral artery leads to wide excisions of glandular structures, with resultant necrosis.

3. Among the three types of periareolar plexuses, the circular type (74 per cent) is the safest one in relation to mammaplasty. The radial type (6 per cent) is the most dangerous because of lack of anastomosis between the periareolar ramifications of the main arteries. Since it is impossible to foretell which variety will be encountered in a given case, the method of choice must be potentially safe in all.

4. In large hypertrophies, mammaplasty should be carried out in two stages. The first stage consists of subcutaneous transposition of the central part of the breast and nipple and wedge-shaped excision from the upper pole of the gland. Final removal of excess glandular tissue and redundant skin is done in the second stage after the "take" of the transposed part. The danger of necrosis is thus eliminated.

5. A single upper skin flap is the safest for use in the first stage in marked hypertrophies. A double flap is preferable in moderate ptosis; here the procedure may be carried out in one stage.

6. The shape of the breast should be outlined by properly adjusted glandular structures and not by an excessively stretched skin which is unsuitable for the maintenance of the mammary contour.

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RENAL ECTOPIA*

A STUDY OF TWENTY-THREE CASES

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THE ectopic kidney is of clinical interest and importance to the abdominal surgeon and gynecologist no less than to the urologist. It may produce bizarre symptoms and is often confused with other abdominal and pelvic tumors. The singular importance of the solitary pelvic kidney (ectopia with contralateral agenesia) and of the unilateral fused kidney (crossed-fused ectopia) to the abdominal and pelvic surgeon are obvious. Their urological significance has been emphasized repeatedly. There is little danger of renal ectopia being overlooked or of accidents occurring, however, if urological disease has been suspected and examination of the urinary tract performed. It is well, therefore, to be aware of the condition and its manifestations.

The series of cases reported here was studied to check the various statistical facts of interest and to determine the relative frequency and clinical importance of the several types of renal ectopia. Few large series have been reported, that of Thompson and Pace[1] (1937) being the largest and most important. Certain forms of renal ectopia also are sufficiently rare to justify individual case reports. One instance of each of the following types are included among the cases reported here: bilateral renal ectopia; crossed, unfused ectopia; and ectopia with contralateral renal agenesia (solitary pelvic kidney).

Definition. Ectopia implies congenital displacement. Renal ectopia may be of several degrees and types. There are three general levels which the displaced kidney may occupy: the low lumbar region or iliac fossa (Fig. 1); on the brim of the pelvis; or below the brim of the pelvis, the true pelvic kidney. (Fig. 2.) The lower the kidney, the nearer the midline it usually lies. Ectopia may be unilateral or bilateral. Both kidneys may occupy a pelvic position and be fused to form a "cake" or "shield" kidney, one of the rarest forms. The kidney may be displaced to the opposite side of the body from its natural position. Such a kidney may then be fused with or lie distal to the other kidney. This is crossed ectopia, fused or unfused, the former being much more common. (Fig. 3.) Crossed ectopia is differentiated from renal duplication with contralateral renal agenesia by the fact

FIG. 1. Bilateral retrograde pyelogram of Case 8. Right renal ectopia; low lumbar position. Note short right ureter excluding renal ptosis.

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that the two ureters open on opposite sides of the trigone.

Incidence. Studies of various autopsy series indicate the incidence of all types of renal ectopia to vary from 1 in 500 to 1 in 1500 necropsies. The clinical incidence is considerably greater. Some forms of renal ectopia are rare. Fowler[2] (1941) reported four cases of bilateral renal ectopia, bringing the total number of such cases to forty. Wilmer[3] (1939) collected 285 cases (with his five) of unilateral fused kidney. Pagel[4] found 14.5 per cent of crossed ectopic kidneys to be unfused in a series of fifty-five cases. Langworthy and Drexler[5] (1942) could find only 20 instances of crossed unfused renal ectopia in the literature. McCrea,[6] in 1942, reported a case of solitary pelvic kidney, bringing the total number of these cases to 35 at that time.

Etiology. The cause of renal ectopia is unknown. Many factors are probably operative in producing the condition; these may be extrinsic as well as intrinsic. Anson, Pick and Cauldwell[7] (1942) recently cited most of the references to the subject. The obstruction to ascent by the many blood vessels, particularly the umbilical arteries, is frequently referred to. This may also force the two metanephric masses into contact and result in fusion (Boyden[8]). Crossed ectopia without fusion is difficult to explain.

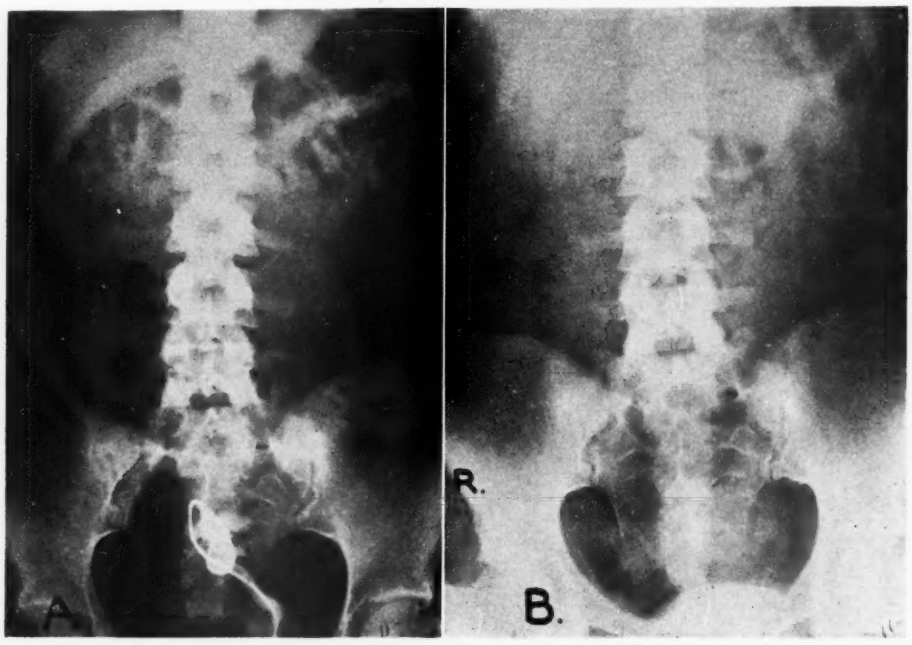

Fig. 2. Pyelograms of Case 12: solitary left pelvic kidney. A, retrograde pyelogram; B, excretory urogram showing filling of left pelvic kidney and bladder with no dye in right renal area.

ANALYSIS OF CASES

Twenty-three cases of renal ectopia were studied. Fifteen of these were autopsy observations and eight clinical. These were all of the cases, through 1942, indexed under this diagnosis at the Los Angeles County General Hospital. There are reasons to believe that some cases have been missed, so no calculations of incidence have been made. These cases are presented in Table 1.

Sex. Sex has not been considered an important factor in renal ectopia. In this series thirteen (56.5 per cent) were females and ten (43.5 per cent) were males. Of the fifteen autopsy cases eight (53.4 per cent) were females. Approximately 40 per cent of the autopsy series as a whole were females; so that the incidence of renal

ectopia in females was 13 per cent higher than in males.

Age. The age distribution of all patients studied is shown in Table II. Of greater interest is the age of the patients seen clinically. Five (62.5 per cent) of these eight patients were under thirty years of age. Of the other three, one was thirty-five, one forty-three, and one fifty. Thus, as with other congenital lesions of the urinary tract, the condition becomes manifest early in life if it is to cause trouble.

Side. The side involved may be of greater importance with some of the particular types of renal ectopia than with ectopia in general. At least, some of the forms of renal ectopia are reported to occur more commonly on one side than the other and this is not true of unselected cases. Ten (43.5 per cent) of the cases reported here involved the right kidney, twelve (52.2 per cent) the left, and one (4.3 per cent) was bilateral. The distribution between right and left kidneys was not influenced by whether the observations were made clinically or at autopsy.

TABLE I

SUMMARY OF CASES OF RENAL ECTOPIA

Case No.	Sex	Age in Years	Autopsy or Clinical	Side Involved	Position	Disease or Other Congenital Urinary Tract Abnormality	Disease or Abnormality of Opposite Kidney
1	Female	24	Clinical	Right	Crossed-fused	None	None
2	Female	64	Autopsy	Left	Pelvic	None	None
3	Male	83	Autopsy	Right	Crossed-unfused	None	None
4	Female	47	Autopsy	Bilat	Both iliolumbar	Right bifid pelvis	No disease
5	Male	55	Autopsy	Left	Lumbar	None	None
6	Female	*	Autopsy	Left	Crossed-fused	None	None
7	Female	43	Clinical	Left	Pelvic	Hydronephrosis and tubular degeneration	Hydronephrosis
8	Male	15	Clinical	Right	Lumbar	Pyelonephritis	Pyelonephritis
9	Female	35	Clinical	Left	Pelvic	Pyelonephritis	Pyelonephritis
10	Male	50	Clinical	Left	Pelvic	None	Ureteral calculus
11	Female	29	Clinical	Right	Pelvic	Pain and infection	None
12	Female	21	Clinical	Left	Pelvic	None	Absent
13	Male	23	Clinical	Right	Pelvic	Ectopic ureteral orifice	Malrotation
14	Male	38	Autopsy	Left	Iliolumbar	Partial duplication of kidney and ureter	None
15	Female	41	Autopsy	Left	Pelvic	None	None
16	Male	†	Autopsy	Left	Pelvic	Ureter blind distally	None
17	Female	71	Autopsy	Right	Pelvic	None	Partially calcified
18	Female	65	Autopsy	Right	Pelvic	None	None
19	Male	35	Autopsy	Right	Iliolumbar	None	None
20	Female	69	Autopsy	Left	Pelvic	None	Partial renal duplication
21	Female	29	Autopsy	Right	Lumbar	Bifid pelvis	None
22	Male	7	Autopsy	Right	Crossed-fused	Chronic glomerulonephritis	Glomerulonephritis
23	Male	‡	Autopsy	Left	Iliolumbar	Upper pole connected to lower pole of right kidney by 2 anomalous veins	Bifid pelvis

* 18 hours.
† Still-born.
‡ 22 months.

Position. The position of the ectopic kidney in twelve cases (52.2 per cent) was pelvic, in four (17.4 per cent) iliolumbar, and in three (13.0 per cent) lumbar. One of the instances of iliolumbar ectopia was bilateral (Case 4). In one of the cases of pelvic kidney (Case 12) there was congenital absence of the opposite

kidney (previously reported (Nation[9]). (Fig. 2.) In four cases (17.4 per cent) there was crossed ectopia; three of these

FIG. 3. Excretory urogram of case of crossed left renal ectopia, apparently fused (patient of Dr. Lyle G. Craig). Left ureter can be seen crossing sacrum to open in left side of bladder.

cases were fused (Cases 1, 6 and 22), and the fourth (Case 3) was an instance of crossed unfused ectopia.

Associated Congenital Defects. In five cases (21.7 per cent) there were other congenital abnormalities of the ectopic kidney than those of form and rotation, which are abnormal in most. In Case 21 the ectopic kidney pelvis was bifid and in Case 4, the patient with bilateral renal ectopia, one of the pelves was bifid. In Case 14 there was partial duplication of the ureter. In Case 13 the ureter opened into the posterior urethra and there was extreme ureterectasis and pyelectasis. (Fig. 4A.) In Case 16 the ureter was blind distally, having no relation to the bladder, and was greatly dilated. In one of the kidneys in normal position the pelvis was bifid and in one there was partial renal duplication. In another there was malrotation. (Fig. 4B.) In Cases 12 and 16 there were associated congenital abnormalities of the genital organs. In Cases 3, 6 and 16 there were other, distant, congenital defects.

In three cases (1, 6 and 22) (13.0 per cent) the adrenal gland was recorded as being absent, on the side of the ectopia. These were all cases of crossed-fused renal ectopia.

The renal blood supply of each case was different, being derived from the vessels of the region occupied by the kidney. The numbers of arteries and veins were variable and they entered all parts of the kidneys. The renal pelvis in most cases was extrarenal, especially in the pelvic kidneys. Daseler and Anson[10] (1943) and Anson, Pick, and Cauldwell[7] (1942) have given excellent anatomical descriptions of ectopic kidneys.

Disease. In addition to the two cases of hydronephrosis resulting from congenital abnormalities of the ureters, there was one instance (Case 7) of bilateral hydronephrosis, with pain in the ectopic kidney. In three cases there was probable pyelonephritis; in two of these patients most of the pain was in the kidney in normal position. In only one case (Case 10) was there disease of the normal kidney without disease of the ectopic one. This patient had a small calculus impacted in the normal ureter. Three patients (37.5 per cent of the clinical cases) were operated upon and the ectopic kidney removed, all primarily because of pain (Cases 7, 11

TABLE II

AGE DISTRIBUTION OF PATIENTS WITH RENAL ECTOPIA

Age in years	<1	1–9	10–19	20–29	30–39	40–49	50–59	60–69	70–79	80–89
No. of patients	2	2	1	6	3	3	2	3	1	1

and 13). Case 11 was previously reported by Rusche and Bray[11] (1943) as their Case 2. The patient with a solitary pelvic kidney (Case 12) was subjected to surgical exploration of the pelvic organs because of the pelvic mass and pain. The absence of the vagina could have suggested preliminary urological study.

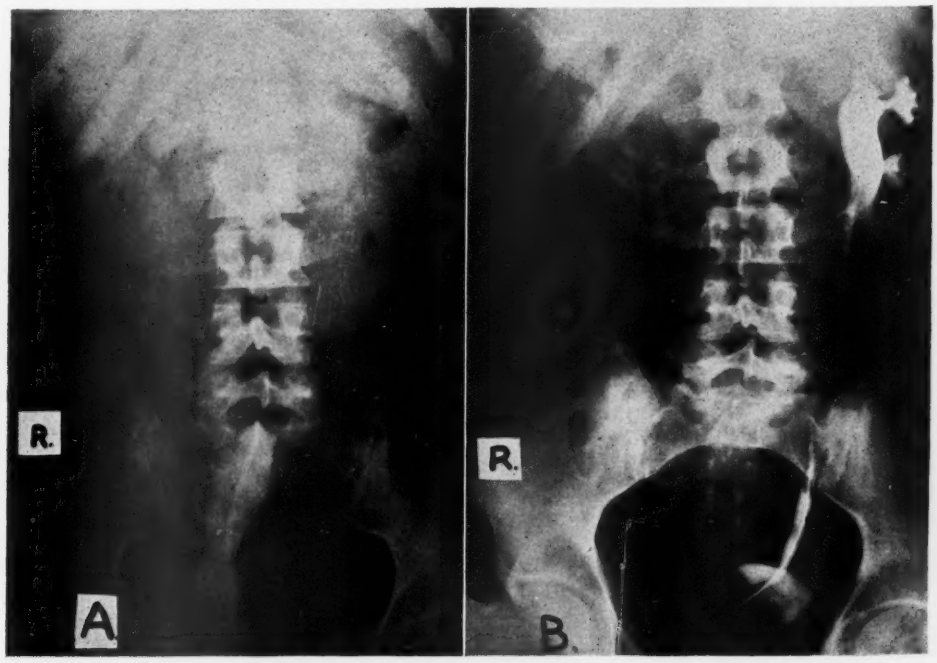

FIG. 4. Retrograde pyelograms of Case 13. A, right pelvic kidney; renal pelvis and ureter blend, being dilated due to ectopic orifice of ureter in posterior urethra; B, malrotation of left kidney.

Blood Pressure. Three of the thirteen patients (23 per cent) on whom accurate blood pressure determinations were recorded had hypertension (Cases 3, 10 and 18). This is of doubtful significance.

SUMMARY

The anatomy, incidence and etiology of renal ectopia are reviewed.

Twenty-three cases, fifteen autopsy and eight clinical, are reported. These were of the following types: lumbar three (13.0 per cent), iliolumbar four (17.4 per cent), pelvic twelve (52.2 per cent), crossed four (17.4 per cent). Of the latter, three were fused and one unfused. There was one instance each of solitary pelvic kidney and of bilateral renal ectopia.

Thirteen of the patients (56.5 per cent) were females and ten (43.5 per cent) males. Renal ectopia was 13 per cent more common in females than in males of the autopsy series (corrected for greater percentage of male autopsies).

The majority of patients seen clinically were young individuals: 62.5 per cent under thirty years of age.

The right and left kidneys were involved with about equal frequency.

In five cases (21.3 per cent) there were other congenital abnormalities of the ectopic kidneys and in four cases there were congenital lesions of the other kidney. Three of these nine lesions were serious.

Pain, usually in the lower part of the abdomen or back, was the chief complaint. Three (37.5 per cent) of the clinical cases of renal ectopia had nephrectomy. However, in the majority of cases, renal ectopia was apparently compatible with comfort and good health.

Urological study should be performed on all patients who have congenital abnormalities of the genital organs.

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The *indications* for nephrectomy are severe kidney trauma, tuberculosis, tumors, extensive chronic or acute infection with destruction of the kidney, large calculi which cannot be removed successfully without removal of the kidney, certain cases of ectopic kidney, and selected cases of hydronephrosis.

From "Operations of General Surgery" by Thomas G. Orr (W. B. Saunders Company).

HEMORRHOIDECTOMY BY INCISION AND DISSECTION

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IN 1926, Pennington reported favorable results with a type of hemorrhoidectomy which was different from the commonly used methods. The operation described below is an elaboration and modification of Pennington's procedure. The author has performed it one hundred twenty times at the Station Hospital to which he is attached, and has found it more satisfactory than any other operation previously used by him, including the Buie type. The essential difference between this type of operation and the usual hemorrhoidectomy is that it consists of an incision and dissection of the hemorrhoidal tumor rather than an excision of the tumor and its covering *en masse*.

TECHNIC OF INCISION—DISSECTION OPERATION

The operation is performed under spinal or parasacral anesthesia. The operating table is "broken" and the patient lies on his abdomen in the flexed position. Adhesive straps, anchored to the sides of the table, are used to hold the buttocks apart. With satisfactory anesthesia, the anal sphincter is completely relaxed, allowing adequate exposure of the entire anal canal and any additional pathological conditions such as fissures, hypertrophied papillae, infected crypts or fistulas, are easily visuzalied.

The skin at the periphery of each hemorrhoidal mass is grasped with Allis forceps and the internal or mucosal extremity of the mass is held up by means of Kocher forceps. The covering of the hemorrhoid between the two clamps is thus held taut and is then incised deeply, after which the edges of the incision are caught with Allis clamps. Treating each half of the incision separately, the Allis clamp attached to the edge is grasped by the thumb on top and the third, fourth and fifth fingers underneath, while the index finger curls around to exert vis a tergo pressure on the external surface of the flap, thus making prominent the deep surface. In other words, the flap is everted or evaginated, with the deep surface now exposed and stretched across the tip and/or ball of the index finger. The actual hemorrhoidal plexuses, thus visualized, are removed with curved scissors by pressing the convex surface of the opened blades against the bulge and cutting the tissue which is thereby forced into the space between the blades. The assistant can be of great help, when necessary, by grasping a clump of hemorrhoidal tissue with toothless thumb forceps so that it can be snipped away more easily. The other half of the incision is next dissected in a similar manner. Bleeding points, especially minute arterioles, are clamped and tied with fine cotton. Venous bleeding usually ceases spontaneously.

In most cases a considerable amount of redundancy of the flaps is left, and this excess is trimmed away in the following manner: The Allis and Kocher clamps at the extremities of the wound are replaced by straight, pointed hemostats, by means of which the incision is held taut and straight. The flaps are approximated by the Allis clamps previously attached to their edges. An Ochsner clamp is then placed beneath the other clamps, the jaws paralleling the edges of the wound, and raised or lowered according to the amount of tissue to be removed. One may remove more from one flap than the other, as conditions indicate, by applying the crushing clamp accordingly, and, likewise, the amount of mucous membrane to be

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removed may be limited by angulating the clamp. When the Ochsner clamp is locked, the redundancy is removed by

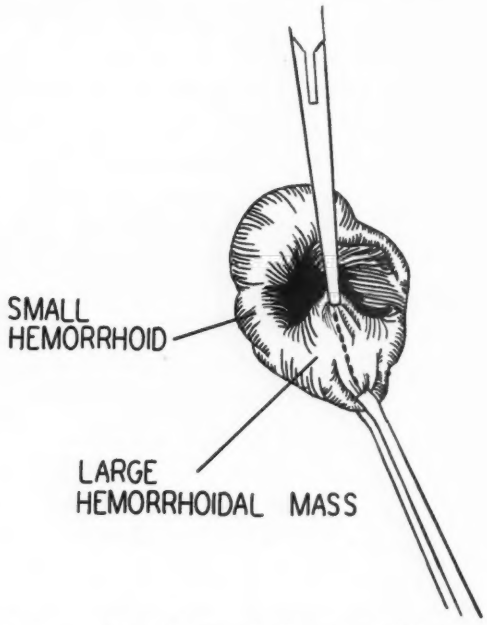

Fig. 1. Attachment of clamps and line of incision over large hemorrhoidal mass.

running a knife closely along the blades. On removing the clamp, the edges of the wound are found to be clean and straight. Any further bleeding which occurs as a result of this last step is treated by individual ligation of bleeding points.

Other discrete hemorrhoidal masses present are removed by separate incisions. In leaving one hemorrhoid to attack another, a change of position of the operator is frequently necessary, but can be avoided if one is ambidextrous. The dissection and undermining of the flaps can be carried out for a distance of one-half of an inch from the edge, so that smaller hemorrhoidal masses contiguous with or adjacent to a larger one can be dissected through the one incision. No intrarectal pack is used for the reason that both its insertion and removal elevate the edges of the otherwise flattened out flaps and thus predispose to postoperative "tags." A vaselined strip of gauze is placed over the wound area and a pressure dressing of gauze and cotton-waste is applied and held firmly by adhesive tape.

Postoperatively, the patient is allowed out of bed after twenty-four to forty-eight hours, at which time Sitz baths are begun. After the sixth day, he is permitted to go to the Mess Hall for his meals and to participate in all the phases of the Hospital Convalescent Training Program, which consists of calisthenics, lectures and craftwork. At the end of two weeks, he returns to duty, with an excuse from hikes and heavy calisthenics for a week, if deemed advisable.

RATIONALE OF PROCEDURE

A hemorrhoid may be considered to be a small tumor mass, the covering of which is skin, mucous membrane and the subcutaneous and submucous tissue. As in the case of a small benign tumor elsewhere, such as a lipoma or a sebaceous cyst, it would appear to be better surgery to enucleate or remove the mass by incision and dissection than to resect the entire tumor and its covering *en masse*. This eliminates the use of sutures, and avoids the removal of an excessive amount of mucous membrane or skin.

ADVANTAGES OF PROCEDURE

Simplicity of Technic. The operation is not difficult to perform. The author, who is a general surgeon, believes that anyone with surgical experience can soon become adept at the technic. The only maneuver which requires some dexterity is the eversion or evagination of the flap by vis a tergo pressure. The tendency of the novice is to pull on the Allis clamp attached to the edge of the flap rather than push with the index finger.

Absence of Complications and Sequelae. The amount of skin and mucous membrane removed in this procedure is reduced to a minimum, thus eliminating the danger of postoperative stricture. In fact, in cases in which large hemorrhoids involve virtually all of the circumference of the anus and in which a modified Whitehead operation would be necessary, a complete "cleaning out" of all hemorrhoidal tissue

can be accomplished by several incisions, and yet no more mucous membrane or skin need be resected than is found

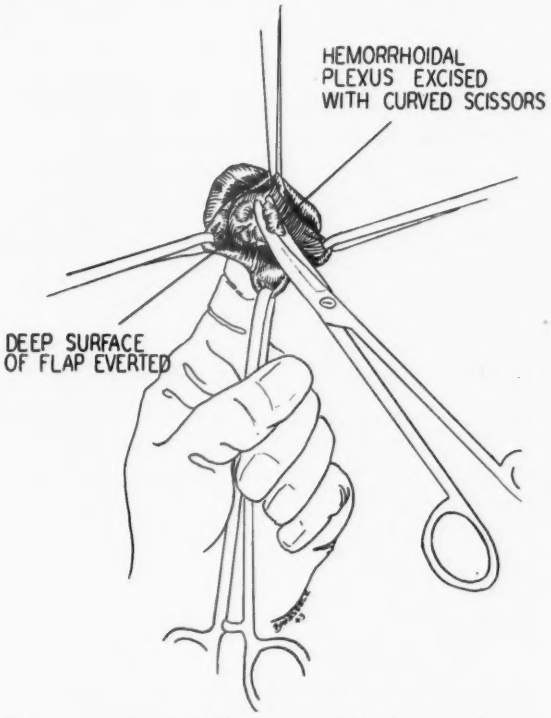

Fig. 2. Excision of hemorrhoidal plexuses from deep surface of one of the flaps, after eversion by means of the index finger. By further eversion, the plexuses in the smaller hemorrhoid shown in Figure 1 can be visualized and excised.

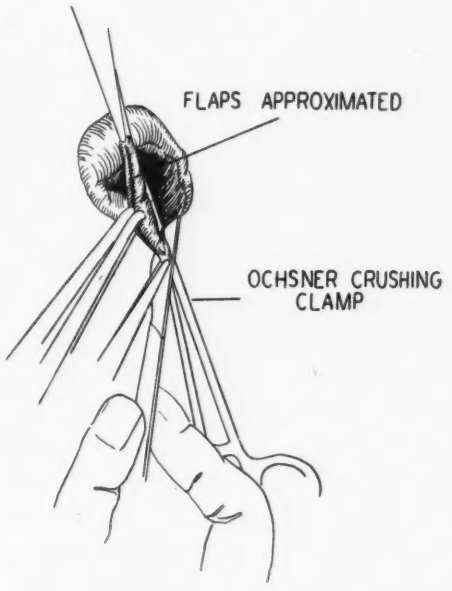

Fig. 3. Removal of redundant skin and mucous membrane.

desirable. Where one attempts to remove two or three "groups" by *en masse* excision, frequently there remain untouched one or more smaller hemorrhoids which intervened between the larger groups. These later increase in size and are frequently the cause of "recurrence." By incision—dissection technic—all masses, regardless of how small they are, can be visualized and excised.

Because no sutures are used and all wounds are left entirely open, adequate external drainage is present and the occurrence of postoperative infection is reduced to a minimum. In this series, no abscesses or deep seated suppurative cellulitis developed.

Diminution of Postoperative Pain and Convalescent Period. Most hemorrhoidectomy patients have been known to complain and elaborate on the amount of postoperative pain they endured, and not without justification. The most startling feature of the postoperative course of the patients operated in this series was the minimal amount of pain and discomfort. An analysis shows that roughly 70 per cent required no postoperative hypodermic injection of morphine, 25 per cent required one injection, and 5 per cent

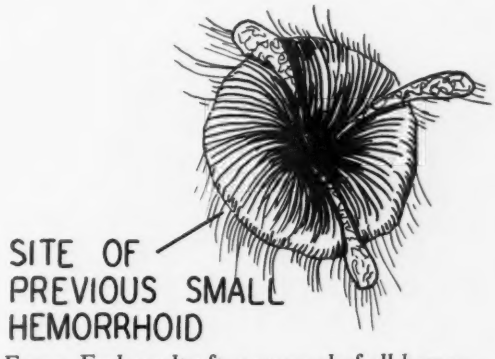

Fig. 4. End result after removal of all hemorrhoidal tissue by three incisions and dissection of adjacent flaps.

required two injections. This is in great contrast to the author's previous experience. Likewise, the first bowel movement did not produce the usual excruciating pain. Patients who had previously been operated upon by another method stated that they had infinitely less pain at the second operation. The most plausible explanation for the diminution of pain is the fact that there are no sutures in the sphincter muscle or elsewhere.

The ability of the patient to return to light activity on the sixth day and to almost full duty on the fifteenth day is of obvious advantage, both in the Army and in civilian life.

Cosmetic Result. If the redundant skin is properly trimmed as described above, and if the use of the intrarectal pack is eliminated, external "tags," which can be a source of distress to the patient, are avoided.

SUMMARY

1. An incision-dissection type of hemorrhoidectomy is described.

2. Experience in one hundred twenty cases shows the operation produces far less pain than other types of hemorrhoidectomy, and allows an early return to full activity.

3. The operation reduces the incidence of postoperative stricture.

4. The operation allows adequate removal of all hemorrhoidal tissue, thus reducing the possibilities of recurrence.

MALIGNANT teratoma consists of heterologous elements in which the three germ layers may be very unequally represented. It may be congenital, develop in infancy but usually appears between twenty and thirty years of age. The growth is variegated, contains cystic areas and in the early state is encapsulated. Seminomas are rare in childhood. Teratomas usually grow more rapidly.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

PILONIDAL CYST

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IN the eradication of pilonidal cyst, the multiplicity of advocated treatments indicates that no generally satisfactory procedure has yet been found. The procedure we have followed in 168 consecutive cases, covered from October 1, 1942, to January 30, 1944, is one of marsupialization. From experience gained, we believe that this simple procedure carried out as indicated will return 90 per cent of the patients to duty in approximately twenty-one to twenty-eight days with complete healing of the pilonidal cyst and sinus. The remaining patients will require a longer period of hospitalization because of separation of skin and cyst wall as a result of infection or trauma.

It is not our intention to add confusion to the already perplexing pilonidal question but, rather, we hope to assist in delineating the correct path to be followed in handling this vexing surgical problem.

Warfare imposes conditions of increased activity, excessive perspiration, macerated epithelium, uncleanliness for varying periods and trauma in the age group in which symptomatic pilonidal sinus occurs; thus, there has been a virtual flood of these cases to military hospitals. To quote White[1] on his splendid editorial on pilonidal cyst, "Circumstances are more propitious for vanquishing obscure complicating factors in the surgical eradication of pilonidal cyst than at any time in the history of the world."

Eradication of the cyst and sinus by block excision without closure, block excision with primary closure, block excision with pedicle flaps, skin graft, local cyst excision, injection of sclerosing agents and electrocautery are all aimed at either removal or destruction of the cyst wall. These methods have left much to be desired. The procedure to be described eliminates the sinus and cyst wall by marsupializing them. Epithelization then progresses rapidly from skin edge to skin edge across the marsupialized cyst.

First, acute cellulitis is treated conservatively with cleanliness, rest and hot packs before any surgery is done. The area is then cleansed and shaved as carefully as would be done for any major plastic operation. The usual location of the pilonidal cyst will be seen in Figure 1A. Under spinal or general anesthesia, a grooved director is passed into the cyst, B. The incision is made the length of the sinus down to and through the cyst wall, C. A section of skin one-eighth to one-fourth inch on both sides of the initial incision is removed with a wedge-shaped portion of subcutaneous tissue, along with the outer one-half to two-thirds of the cyst wall, leaving the deep portion of the cyst wall remaining in its bed. (Fig. 1D and E.) This excision permits the skin edges to be brought down to the remaining portion of the cyst wall without tension and without subcutaneous fat bulging between the skin edge and cyst wall. (Fig. 1F and G.) The skin edge and cyst wall are approximated with interrupted No. 40 cotton sutures. The wound is then packed open with a plain, dry, close-meshed gauze pressure dressing.

This dressing is not disturbed for seven or eight days unless cleanliness demands. The sutures are removed on the seventh to tenth day. After the initial dressings, treatments of radiant heat, fifteen minutes twice daily, are valuable in keeping the wound dry and encouraging epithelization.

In the course of operating and observing the postoperative course of these 168 cases, we have learned certain lessons and made observations which we believe will aid

in lowering the incidence of recurrence and in decreasing the period of hospitalization. None of the patients was discharged from the hospital unless complete healing had occurred, and the patient was able to return to full military duty. In arriving at our present procedure as described, the patients in the 168 cases reported were operated upon by nine surgeons all using the same general technic except for differences of opinion as to choice of anesthesia, the amount of skin or cyst wall removed, the type of dressing applied and the postoperative care.

The choice of anesthesia is one of the most important points in the surgical treatment of pilonidal cyst. Reference to Tables I and II is impressive as to the results obtained with local and spinal anesthesia. It is significant to note that the forty-seven patients operated upon under spinal anesthesia had an average hospitalization period of 21.1 days. The 116 patients operated upon under local

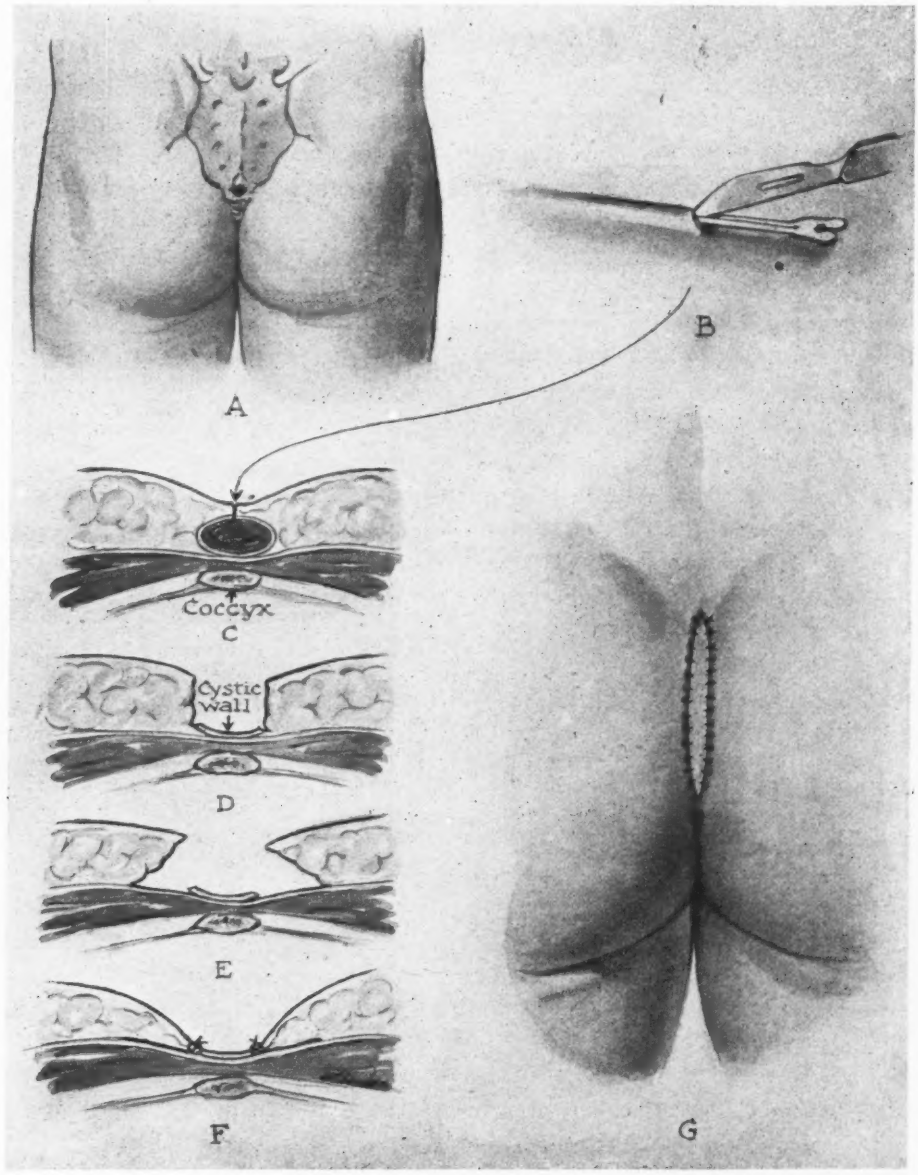

Fig. 1. Drawings showing usual location of cyst with the steps in marsupialization technic.

anesthesia had an average hospitalization period of 46.8 days. There were no complications or recurrences when spinal anesthesia was used. There were five recurrences and six severe infections following local anesthesia. We no longer use local anesthesia.

The type of dressing is important. It has been found that a close-meshed, plain, dry gauze dressing applied next to the remaining cyst wall and skin with firm pressure is the most satisfactory dressing. Dressings of vaseline gauze or sulfa-impregnated gauze delay wound healing. The recurrences and infections occurring with local anesthesia are believed to be due to tissue distortion and to the spreading of infection by the needle from contaminated sinus tracts to clean tissues. Under spinal anesthesia, with direct visualization and inspection, no difficulty has been encountered in finding all ramifications. All lateral extensions are followed by the probe and the same surgical treatment of skin and cyst wall applies.

TABLE I

AVERAGE DAYS IN HOSPITAL OF CASES DONE UNDER SPINAL ANESTHESIA—NOTE DIFFERENCES AS TO TYPE OF CYST AND TYPE OF DRESSING—COMPARE WITH TABLE II SHOWING RESULTS IN PATIENTS OPERATED UPON UNDER LOCAL ANESTHESIA

	No. of Cases	Average Hospital Days
Type of Lesion		
Cyst only	5	19
Abscess and sinus	9	25.3
Dry sinus and cyst	3	24
Draining sinus and cyst	30	21.5
Total and Average	47	22.1
Type of Dressing		
Sulfathiazole gauze	22	29
Sulfathiazole powder and vaseline gauze	9	26
Plain gauze pressure dressing	16	20.6
Complications	0	
Recurrences	0	

TABLE II

RESULTS OF OPERATIONS DONE UNDER LOCAL ANESTHESIA

	No. of Cases	Average Hospital Days
Type of Lesion		
Cyst only	8	51
Abscess and sinus	14	59.2
Dry sinus and cyst	7	32.5
Draining sinus and cyst	87	45.6
Total and Average	116	46.8
Type of Dressing		
Sulfathiazole gauze	49	66.4
Sulfathiazole powder and vaseline gauze	40	52.6
Plain gauze pressure dressing	27	31.8
Complications		
Recurrences	5	
Severe infections	6	

The average age of the patients was twenty-three. Eleven or 6.7 per cent of the patients had had a severe blow to the coccygeal region within the month preceding admission. Twenty-seven or 16.5 per cent were recurrences from surgery elsewhere. Reference to the operative reports shows that the patients who had one-half inch or more of skin removed required an average of 69.1 days for healing, while those with less than one-half inch required an average of 23.8 days.

CONCLUSIONS

1. This is a plastic operation, and the best results are obtained if the skin and cyst wall incisional defect be not wider than 2½ cm. to 3 cm. along the course of the cyst or any of its sinus ramifications, because epithelization and cornification progresses slowly if the defect is any wider.

2. Local anesthesia increases the complications, period of hospitalization and the number of recurrences.

3. Dry gauze pressure dressings are best.

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DICUMAROL IN SURGERY

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MANY articles have recently appeared on various aspects of dicumarol, but none has dealt with all of its important aspects. This paper is written as a review of the subject in an effort to correlate all the facts into a workable thesis. An attempt will be made to present the more plausible viewpoints with a few comments.

Dicumarol is a compound found in spoiled sweet clover and for many years has been known to cause hemorrhagic disease in cattle. Through the untiring efforts of Link[14] and others the product has been synthesized. It has been available for clinical use for several months. However, it still may be considered to be in the experimental stage. When dicumarol is given orally in sufficient quantity, there is a lowering of the prothrombin content of the blood which is detectable by an increased prothrombin time. It is of greatest use in the prophylaxis and treatment of phlebothrombosis and thrombophlebitis.

The mode of action of dicumarol remains highly theoretical. Wakin and Gatch[15] believe that prothrombin is formed in the liver and that dicumarol depresses either its formation or activity. They presented no proof of its interference with liver function. Davidson and McDonald[16] found the drug to act by diminishing the effective prothrombin concentration in the blood. According to Barker[3] the prolonged prothrombin time produced by dicumarol is thought to be due to decreased prothrombin formation.

It is agreed by many[3,6,9,11,12,13] that dicumarol definitely prevents thrombus formation or its extension when the prothrombin time is appreciably elevated. Barker[3] found that thrombosis is rare if the prothrombin time is above twenty-seven seconds. There is an individual susceptibility to its action[1,8] thus often making it difficult to control the effects produced. Dicumarol should be administered cautiously and only if properly controlled. A prothrombin determination and blood typing should be performed before administering dicumarol. Thereafter a daily prothrombin time must be performed and each dose of dicumarol prescribed separately, having full knowledge of the prothrombin time. Standing orders must not be placed and doses should be given only as specified above. A prothrombin time is without value unless a control is run. The determination loses much of its value unless performed immediately[10] after collecting the specimen because the prothrombin time increases in direct proportion to the amount of time that elapses before performing the determination.

Untoward effects occur but they do not present a major problem nor do they prohibit the use of dicumarol when definitely indicated. Practically the only untoward reaction of any importance found in the literature[2,3] is that of hemorrhage. Hemorrhage may be from the gums, nose, urinary tract, into subcutaneous tissue from slight trauma but more often into the operative wound. According to Lehmann,[9] of Sweden, one case in every ten treated will develop some type of hemorrhage but the complication can be satisfactorily combatted by the use of large doses of vitamin K or fresh whole blood transfusions. Barker[3] reported minor bleeding in 5.3 per cent and major bleeding requiring transfusions in 3.2 per cent of cases receiving dicumarol. Barker,[3] DeBakey[7] and others[16,17] report vitamin K to be

ineffective in lowering the prothrombin time following the administration of dicumarol. On the contrary Davidson and McDonald[6] were able to prevent and reverse the effect of dicumarol upon the prothrombin time by the use of vitamin K. They used a dosage of 250 to 500 mg. of vitamin K in their experiments. The reversal may be rather rapid when vitamin K is given parenterally. Most writers agree that the bleeding tendency can be adequately combatted by fresh whole blood transfusions.

The usually recommended dosage of dicumarol is as follows:[3] 300 mg. by mouth initially, 200 mg. the following day, and 100 mg. each succeeding day that the prothrombin time is below 35 seconds. In the writer's experience this dosage has been excessive. The following is recommended as a safer procedure: original oral dose of 200 mg. followed by 100 mg. the next day and no additional dicumarol until the end of forty-eight hours. Often no appreciable change in prothrombin time is noted until forty-eight or seventy-two hours have elapsed. It is obvious that trouble may ensue if the drug is given in large doses before it is possible to determine the susceptibility of the individual. There is an increased danger of hemorrhage if dicumarol is given earlier than sixty hours postoperatively and preferably seventy-two hours should elapse before it is administered. The desired prothrombin time is the range between 60 and 30 per cent of normal. The bleeding tendency increases rapidly as the prothrombin time approaches or exceeds 20 per cent of the normal.

There is a minority group of surgeons who more or less condemn the use of dicumarol, especially as a prophylactic measure. DeBakey and Zava[7] doubt the merits of dicumarol on the basis that the mode of action is unknown and likewise that there is not complete agreement as to why thrombo-embolization takes place. They believe furthermore that thrombo-embolization is a rare postoperative complication when other well known prophylactic measures are instituted. Zava[7] reported six thousand postoperative pelvic cases without a single incidence of embolism. According to them, the toxic effects and the danger of hemorrhage are too great to warrant the use of dicumarol as a prophylactic measure.

The prophylactic use of dicumarol is gaining in popularity. No one has recommended that it be used instead of the time proven measures in the prevention of thrombo-embolization but rather as an adjunct. It is obvious that it should not be used in every major postoperative surgical patient; neither should it be used indiscriminately. Barker[3] has given dicumarol to a large number of surgical patients during the immediate postoperative period. He gave it to patients who were more or less predisposed to thrombo-embolization because of having had the complication previously or who had undergone operations which are known to predispose to the above mentioned syndrome. There was another group which was given dicumarol prophylactically because of operations associated with obesity, varicose veins, anemia, heart disease, and trauma to large veins during surgery. There was a remarkably low incidence of thrombo-embolization or recurrence of thrombo-embolization in Barker's series. Dicumarol seems to be particularly indicated following extensive pelvic surgery, following cesarean sections, in peripheral vascular disease[1] and crushing injuries of the extremities.[4]

Most encouraging reports[13,18] have been published on the use of dicumarol in the treatment of phlebothrombosis, thrombophlebitis, and subsequent embolization. According to most writers there is no change in the thrombus already present but rather no extension of the thrombotic process. Shapiro and Sherwin[13] found there was a definite decrease in the convalescent period and that the thrombophlebotic patient was more comfortable. Lehmann[9] reported a recovery period of one to three

weeks in patients with thrombophlebitis who received dicumarol as compared to a recovery period of five to eight weeks when the anticoagulant was not administered. All who have used dicumarol extensively as a therapeutic measure agree that it shortens the period of convalescence in the presence of thrombophlebitis.

There is some disagreement as to the contraindications to the use of dicumarol. A better explanation would be that there are very few absolute contraindications and that most contraindications are relative. A bleeding or hemorrhagic tendency and impaired liver function with definite prothrombin deficiency should probably be listed as absolute contraindications to its use. However, seldom would the necessity arise for its use in the presence of the above named conditions. Barker[3] listed these relative contraindications: "1. Ulcerative lesions as open wounds with potential bleeding tendency. 2. Necessity for secondary operations in two weeks. 3. Vomiting due to intestinal obstruction or use of continuous suction. 4. Operation on brain or spinal cord."

SUMMARY AND CONCLUSIONS

A brief review of the literature, with some additional comments, has been presented. There are relatively few skeptics and admittedly they have not used dicumarol extensively. According to those who have used the drug extensively it is a valuable prophylactic and therapeutic measure in thrombo-embolization. The untoward reactions presented were not severe enough to prohibit its use. The bleeding tendency which occurred in a small percentage of cases can be adequately combatted by large doses of vitamin K and unquestionably by fresh whole blood transfusions. Apparently there is no contraindication to its prolonged use. The writer has used it almost continuously in one case for six months without untoward reactions. It should again be stressed that dicumarol must be given cautiously and be adequately controlled by frequent prothrombin determinations.

There is a decided decrease in the convalescent period of thrombo-embolization when dicumarol is adequately administered. It is believed that there is likewise a decided decrease in the incidence of postoperative thrombo-embolization when dicumarol is prescribed as a prophylactic precaution. It is of special prophylactic value during the postoperative course of patients who have undergone pelvic operations, especially cesarean sections or in other cases in which there is any reason to fear occurrence of thrombo-embolization. The beneficial effects are not well understood, but the writer predicts that the lowering of prothrombin time is not the only beneficial effect. This prediction is made on the basis that often the septic fever and general malaise in an individual with thrombophlebitis will subside in forty-eight to seventy-two hours.

The writer believes that dicumarol will deservingly win an enviable place in our armamentarium. It is not presented as a substitute form of therapy but as a valuable adjunct to other therapeutic measures.

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Many conservative operations on the blood vessels have been marred by functional failure, a physiological fault rather than an operative imperfection. This is due to thrombus formation occurring on the damaged intima and spreading peripherally to affect the collateral vessels.

From "Surgery of Modern Warfare" edited by Hamilton Bailey (The Williams and Wilkins Company).

EPIGASTRIC HERNIA

AN IMPROVED METHOD OF REPAIR

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THE repair of midline hernia has received comparatively little attention, probably because of the relative infrequency of this lesion. Epigastric hernia occurs in approximately .08 per cent to 4.6 per cent of all hernias in different series. However, various reports have shown that the incidence of recurrence in epigastric hernia is high, ranging from 3 to 14.2 per cent. In the series of Glenn and McBride, the highest incidence of recurrence in primary hernias is in the epigastric type.

When one considers that epigastric hernias are in the upper abdomen and that this portion of the abdominal wall is more prone to wound disruption and postoperative herniation, the aforementioned statistics would not be unusual. The reasons for this are: (1) the greater effect of respiration on the upper abdomen, and (2) the presence of solid fixed viscera there in contradistinction to the lower abdomen.

There are two types of repair generally used for epigastric hernia: The first is that method wherein the linea alba is split above and below the hernial ring opening into it. The protrusion of proxperitoneal fat or the true sac is then dealt with accordingly. The two leaves of the linea alba are then merely approximated vertically with a simple or an imbricating suture.

In the alternate type of repair, after the linea alba is split above and below the ring and the sac or fatty herniation ligated, the rectus sheaths on either side are opened and the repair is done in layers. Ordinarily, the incision into the sheaths is made anteriorly and medially at a point where the sheaths fuse to form the linea alba. (Fig. 2.) In this standard type of repair, when the rectus muscles are exposed by incising along the anterior layer of the sheaths, bilaterally, the posterior layer of the repair would include the linea alba. (Fig. 3A.) In the upper abdomen, the linea alba is not just a linear marking of the fusion of the sheaths as it is in the lower abdomen. Above the umbilicus, the linea is from ½ to ¾ of an inch in width. In the layered repair when the linea alba goes with the posterior sheaths by virtue of the type of incision made in exposing the rectus muscles, it makes for an easy approximation of the posterior layer of the repair. In the next layer, the muscles are then sutured together in the midline. The third layer is the approximation of the anterior sheath. In doing this type of repair, it has been observed in every instance that this anterior layer approximates with difficulty and under considerable tension, even in the most relaxed abdominal wall. The reason for this is, that when the rectus sheaths are incised anteriorly, it immediately gives the benefit of the extra width (½ to ¾ of an inch) of the widened linea alba to the repair of the posterior layer at the expense of the anterior. This can readily be seen in the illustration. (Fig. 3A.)

In order to obviate this, a new technic has been devised in which the amount of tissue both anterior and posterior will be equalized, thus taking the strain off the anterior row of sutures in the repair. This is done in the following manner: The skin and the subcutaneous tissue are incised vertically over the hernial protrusion, exposing the mass with the linea alba above and below. (Fig. 2 in cross section.) The medial margins of the rectus sheaths are also identified. The linea alba is split above

and below the protrusion for about 2 cm. If the hernia is just a properitoneal fatty protrusion, it is simply ligated with its accompanying blood vessel. If there is a true sac present, it may be ligated without opening, if the contents have been reduced. When the abdomen has to be explored, of course the sac is opened. When the sac has been opened, the peritoneum and transversalis fascia are included in the repair of the posterior layer. When there is no sac present, or there is not specific reason for opening the sac, the peritoneum and transversalis fascia are bluntly dissected from the posterior sheath and treated as a separate layer with a purse-string or a continuous suture. The repair is then begun by opening the rectus sheath.

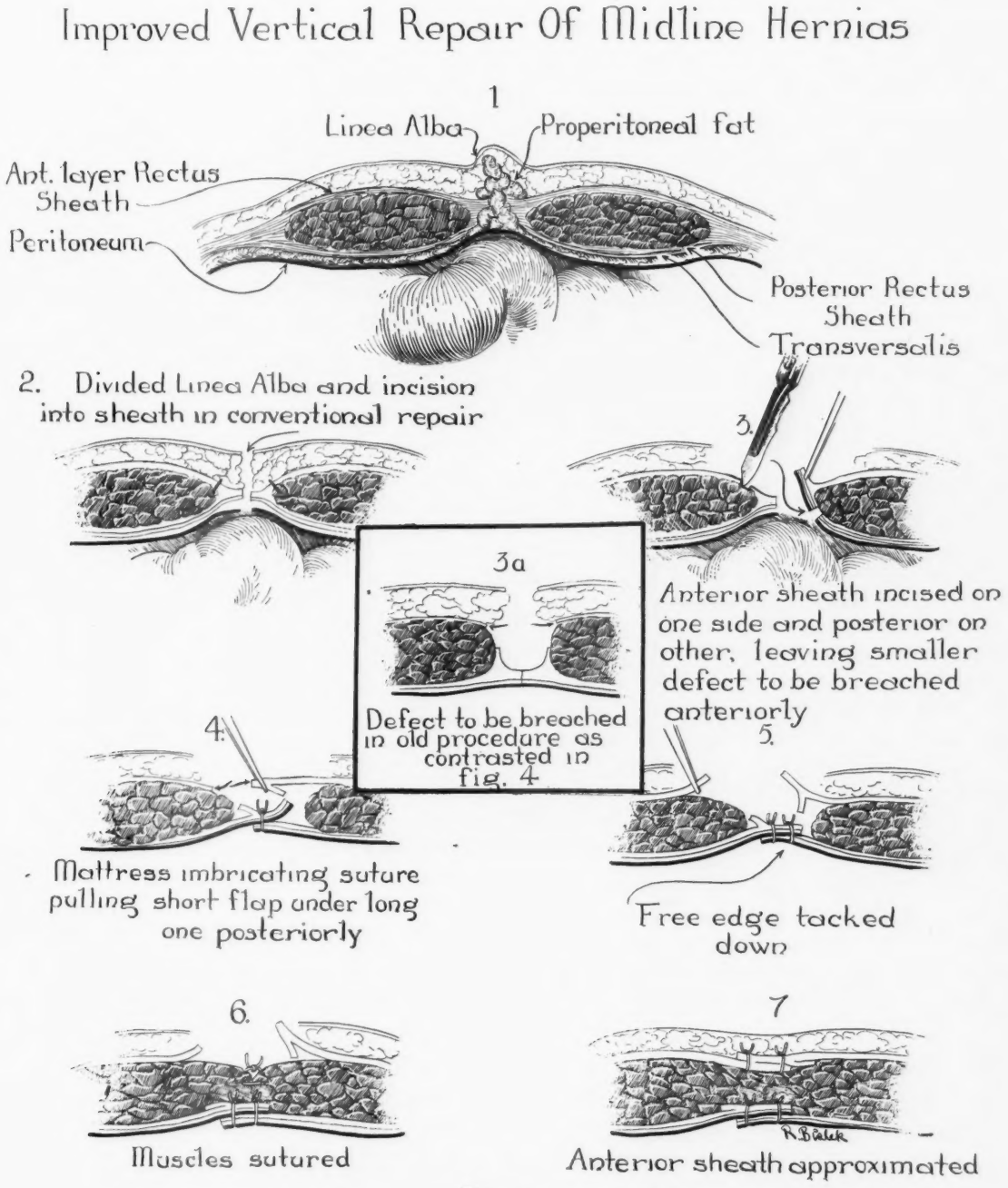
Improved Vertical Repair Of Midline Hernias
1
Linea Alba
Properitoneal fat
Ant. layer Rectus Sheath
Peritoneum
Posterior Rectus Sheath
Transversalis
2. Divided Linea Alba and incision into sheath in conventional repair
3.
3a
Anterior sheath incised on one side and posterior on other, leaving smaller defect to be breached anteriorly
Defect to be breached in old procedure as contrasted in fig. 4
4.
5.
Mattress imbricating suture pulling short flap under long one posteriorly
Free edge tacked down
6.
7
Muscles sutured
Anterior sheath approximated

FIG. 1.

But this is not done in the conventional manner. Instead of opening both sheaths along the anterior margin at the point of fusion, a different step is taken. On one side, the sheath is opened anteriorly at the line of fusion, and on the other, the flap of linea alba is lifted and the sheath is incised posteriorly. (Fig. 3.) This makes for one long and one short flap to be approximated in both the anterior and the posterior layer, with an equal amount of tissue in both. When sutured, the tension on the two layers is the same. (Figs. 4, 5 and 7.) This is in contrast to the conventional type of repair in which both posterior flaps are long and are approximated under no tensions and both anterior flaps are short and are sutured with difficulty.

In the repair, imbricating mattress suture of non-absorbable material is used, such as silk or fine (No. 34) steel wire. (Fig. 5.) The muscles are sutured as the middle layer with a simple suture of the same material. (Fig. 6.) The skin is closed as desired.

Five epigastric hernias have been repaired in this manner. The technical procedure is simple and obviates any excess tension on the repaired tissues. The incidence of recurrence cannot, as yet, be evaluated.

CONCLUSIONS

A new method of repair of epigastric hernias is offered which decreases the technical difficulties and may well improve the high incidence of recurrence of this type of lesion.

Acknowledgement is hereby made of the assistance and advice of Dr. Alfred Ullman, Chief of Surgical Service, Sinai Hospital, in the preparation of this report.

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TUBE FEEDING*

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FOR obvious reasons usually a certain number of hospital patients require alimentation via a rubber tube. They are to be found on medical as well as on surgical wards. Neuropsychiatric patients, for instance, are frequently gavaged because they will not eat. Surgical patients many times receive their food through either a nasal or gastrostomy tube because they otherwise cannot eat.

The fact that the feeding must be fluid in character does not in itself preclude a well balanced dietary. Unfortunately, many tube feedings are not adequate. In devising the one here presented care was taken to see that it meets the criteria of adequacy.

In formulating this feeding we attempted to select easily available items which, when mixed together in proper proportions, yield a readily assimilable diet which is adequate in the essential food substances, vitamins and minerals. The constituents were chosen because of their value and not because of their cheapness which so often is allowed to become the major consideration. Even so the cost of the preparation is a nominal one.

The diet is so constructed that a unit volume (2,300 cc.) yields 2,600 calories, which is slightly more than the daily requirements of a sedentary 70 Kg. man. It is easy, therefore, to assign a relative proportion of the mixture, either more or less as the case may be, to any given individual. For instance, it is simple enough to order the standard formula increased or decreased by a certain percentage, say 10 per cent. This affords the minimum of calculation for the individual who prepares the diet.

The protein fraction has purposefully been increased well beyond the daily requirement of this constituent because the patient who needs tube feeding is almost universally one who has suffered some degree of protein starvation.

The relationship between carbohydrates and fats is in the ratio of 2:1.

The composition of the diet is contained in Table I. The constituents are listed in the left hand column. The weight of each, the measure, and the caloric yield are listed in the next three columns. The number of Gm. of protein and the number of mg. of calcium and iron are next given. The last six columns are used to show the vitamin content of each component. At the foot of the chart the columns are totalled for comparison with the daily requirements of a sedentary 70 Kg. man (as recommended by the Committee on Foods and Nutrition of the National Research Council) which is recorded in the last line.

The allowable substitutions are listed in Table II. The number at the extreme left corresponds with the item of the same number in the preceding chart for which it may be substituted.

The feeding should be prepared each morning and kept under refrigeration until it has been used. Careful corking is necessary to prevent depletion of the contained vitamins.

Since proprietaries are used in this preparation it is appropriate that a statement regarding each be included. Aminoids are used as an adjunct protein source. They are composed of amino acids, dipeptides and prior nitrogenous molecules derived from milk, beef, wheat and yeast. These comprise 45 per cent by weight. Another 44.3 per cent is made up of carbohydrates (dextrose, lactose, maltose and sucrose). It furnishes 102 calories

* From the Barnard Free Skin and Cancer Hospital, St. Louis, Mo.

per ounce. All of the essential amino acids are present.

Dexin is a very light weight sugar which is composed of dextrins 75 per cent, maltose 24 per cent, mineral ash 0.25 per cent and moisture 0.75 per cent. The advantage of dexin over granulated sugar is the fact that it is largely composed of non-fermentable dextrins which lessens the tendency toward intestinal fermentation with gas formation. The small proportion of maltose present is readily assimilated before fermentation can occur and the enzymic hydrolysis of the dextrins is sufficiently slow to permit absorption of the dextrose about as fast as it is formed. Dexin is 99 per cent carbohydrate and yields 4 calories per Gm. or about 115 calories per ounce (28.35 Gm.).

Drisdol (brand of crystalline vitamin D from ergosterol) with vitamin A is used as only four drops of it are necessary to furnish one and one-quarter times the minimum daily requirement of vitamin A and two and one-half times the minimum daily requirement of vitamin D.

It will be noted that only the yolks of eggs are used. The egg whites are discarded because they are not actually needed and because they are high in avidin which is the antagonist of biotin (vitamin H or coenzyme R) which is contained in the yolk fraction of the egg. We do not know too much about biotin but we do know that such conditions as retarded growth, fatty liver, atrophy of the tongue, weakness, muscle pains, anorexia and a dermatitis are said to develop when this substance is absent or present in deficient amounts.

TABLE I

	Weight		Measure	Calories	Protein Gm.	Calcium Mg.	Iron Mg.	Vit. A I.U.	Thiamin Mg.	Ascorbic Mg.	Riboflavin Mg.	Vit. D I.U.
	Gm.	Oz.										
1. Milk (whole)	1950	...	2 quarts	1350	64.8	1324.	4.76	3770	1.032	40	4246	270
2. Tomato juice	125	4.4	½ cup	30	1.2	7.5	.75	1065	.115	29	.062	
3. Orange juice	122.5	4.3	½ cup	67.5	.75	30.5	.365	275	.134	66	.018	
4. Egg yolks	64	2.4	4 yolks	224	9.6	100	5.32	2400	.252	...	.360	
5. Aminoids	120	4.0	.....	408	54.0							
6. Dexin	120	4.0	24 Tb.	460								
7. Drisdol	.....	...	4 drops	.....	.....	.....	.....	....	.....	...	.....	1000
8. Table salt	.....	...	½0 ts.									
9. Molasses	23	0.8	1 Tb.	65	0.6	59	1.63					
10. Yeast extract (Vegex)	7	0.2	1 ts.	10	2.3	4	3.36	....	.735	...	.630	
Total	.....	...	.....	2614.5	133.25	1342 mg. or 1.34 Gm	16 mg.	7510	2.2	135	5.3	1270
Requirements for a sedentary 70 Kg. man	.....	...	.....	2500	70	0.8 Gm.	12 mg.	5000	1.5	75	2.2	

TABLE II

5′ Soybean flour	100	...	1 cup	400	37.3	379	2.7	200–500 micrograms	600–1200 micrograms		600 micrograms	
6′ Granulated sugar	104	4.0	8 Tb.	400								
7′ Cod liver oil	9	.3	1 Tb.	99								
10′ Brewers yeast	7	.2	1 Tb. or 21 tablets	24	3.5	6.0	1.12	.....	1.050	...	.490	

CONCLUSIONS

A recipe is given for a liquid diet which is suitable for passage through a rubber tube before entering a patient's stomach. It is well balanced as regards the carbohydrate-fat ratio and the mineral and vitamin content. The protein fraction has purposefully been increased above the daily requirements for this food substance. The diet is easily prepared. Each cc. yields more than one calorie.

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JOINT ASPIRATION

A SIMPLE METHOD

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ASPIRATION of the knee joint has been looked upon by many physicians and by the laity as a formidable procedure. The physician fears the possibility of introducing an infection into the joint. He believes that the benefits derived from the usual type of aspiration do not compensate for the hazards or the discomfort and pain to the patient. The patient fears aspiration because of the anticipated pain and his impression that joint surgery, even in this form, may result in a stiff part.

Aspiration of a joint can play a very important diagnostic, prognostic, and therapeutic rôle in traumatic joint disorders.

Diagnostically, the presence of a clear serous fluid usually denotes irritation to the synovial lining of the joint cavity. This irritation is produced by direct trauma to the capsule of the joint or severe sprain of the ligaments supporting the joint. A hemorrhagic fluid is the result of laceration within the joint cavity. Fat globules in a hemorrhagic fluid usually indicate a tearing of the fat pad. If the fat globules are large and prove to be bone marrow cells, it is evident that a fracture into the joint has occurred even though this may not be visible in the roentgenogram; for example, a fracture of the tibial spine into the knee joint. Once having arrived at a more accurate diagnosis, one can better determine the prognosis and treatment.

Therapeutically, aspiration of joint fluid relieves tension and discomfort. It also shortens the convalescent period because only a small amount of joint fluid remains to be absorbed by the already injured and edematous synovia. Aspiration of hemorrhagic fluid decreases the tendency toward fibrous adhesions. By decreasing the joint tension circulation is improved and recovery is hastened accordingly.

A simple method of joint aspiration has been used by the author with complete satisfaction. In presenting his technic he makes no claim to originality with respect to the method but presumes it has been utilized by others. The technic involves the use of the following items: (1) An elastic flat rubber bandage roll, measuring three inches wide and three yards long with two twelve inch cotton tapes at one end to act as ties; (2) a No. 17 gauge three inch needle, and (3) a 30 cc. syringe.

The procedure is used most frequently for aspiration of fluids at the knee joint (Fig. 1), but it may also be used for aspiration of fluids from other joints. The technic used in aspiration of the knee joint is as follows: The knee is held in extension. The rubber bandage is wrapped snugly about the joint in the form of a figure-of-eight. It extends about three inches in both directions and is tied about the leg with the cotton tapes. One small area, about the size of a silver dollar, is left uncovered. This area includes the desired point of entry of the needle and is located preferably over the medial aspect of the patella.

The firm elastic pressure distributed equally throughout the entire joint, except the exposed area, compresses the fluid from all sections of the joint cavity toward this exposed area. The fluid pressure forces the medial aspect of the patella upward, away from the medial femoral condyle, and the collection of fluid produces a localized bulging of the capsule. The former allows for a greater area, the latter for an easier site in which to enter the joint cavity.

Once this localized, bulging, fluctuant tumor mass is visible, the examiner will notice an increasing cyanosis of the area. The cyanosis is due directly to the impair-

ment of circulation caused by the tourniquet effect of the elastic bandage. This increasing cyanosis varies directly with an

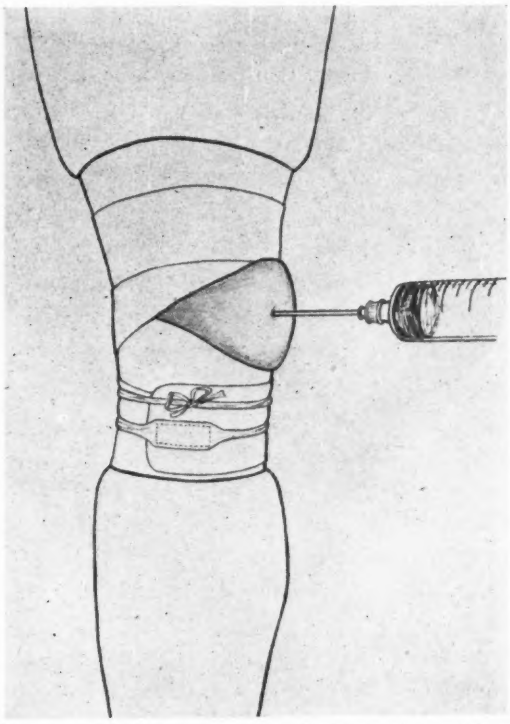

Fig. 1. Rubber bandage applied to a knee joint partially filled with fluid. The elastic pressure forces the joint fluid to one localized area. The impairment of circulation to this area results in complete anesthesia. Elastic pressure forces the fluid into the syringe.

increasing hypesthesia in this area. In fact, sensation becomes so diminished that for practical purposes, a complete anesthesia results in one to two minutes. Not only the skin, but all layers of soft tissue in this area overlying the joint become anesthetized. Because of this anesthesia, the use of a local anesthesia, such as novocain, is unnecessary.

With a pool of fluid concentrated in one small area, the patella lifted away from the medial femoral condyle, and all layers of soft tissue overlying this area completely anesthetized, the operator will encounter no difficulty whatsoever in thrusting a needle into the joint space. The procedure is as simple as entering a vein and does not require any more preparation of the skin than is necessary for the most simple phlebotomy. The possibility of the needle striking the cartilagenous surfaces of the joint is avoided and thus a painful injury is prevented.

A skin antiseptic is applied over the exposed area. A No. 17 gauge needle attached to a 30 cc. syringe is quickly thrust into the bulging pool of fluid. The insertion of the needle is practically painless and is performed with a single thrust. Once the needle pierces the synovial lining, the tension force caused by the elastic compression results in a rush of fluid into the syringe, slowly raising the plunger. Upon several occasions the author used no syringe and the resulting compression force of the elastic bandage was so great that it caused the fluid to gush as much as ten feet across the room. Once the syringe is partially filled, it is disconnected from the needle and the remainder of the joint fluid is caught in a small basin. The needle is not held. The patient internally rotates the knee so as to take advantage of gravity. As the fluid is removed, the patella may depress onto the bevel of the needle, thus preventing complete aspiration. By rotating the needle about one-quarter turn the obstruction is eliminated. When the fluid ceases to drain, the needle is removed. A dry, sterile dressing is placed over the puncture site and the rubber bandage is removed. An elastic bandage is then applied. The procedure is completed, and the patient is allowed to walk to his bed.

The author has aspirated more than 200 knee joints, in addition to an occasional aspiration of the ankle and elbow joints by this technic without any complications. Even the most frightened patient leaves the table content in the fact that he has been relieved considerably of his symptoms without the slightest degree of pain.

CONCLUSION

A simple method for aspiration of joints has been described.

INVERSION OF THE APPENDICEAL STUMP

AN IMPROVED METHOD

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MANY both simple and complicated methods of stitching so as to invert the appendiceal stump after appendectomy have been described. However, after having tried them all and finding it difficult, at times, to make a nice, clean, complete inversion of the stump, the writer has improved upon the method of Ochsner and Lilly[1] and of Spencer,[2] which are the best so far. I apply a little trick which is a big help in the actual inverting process. The following is a simple and effective technic:

After tying the meso-appendix and cutting it away from the appendix, the site selected for amputation is not crushed. It is just tied off at a distance of about one-third inch from the cecum with a plain No. 0 catgut, using a granny knot (the idea being that a few hours later the knot will open into the lumen of the gut). A purse-string suture is placed about the appendiceal base, using No. 000 or No. 0000 chromic on an atraumatic needle and placing the first stitch in such a manner that when the purse-string suture is tied, the appendiceal artery will be included in the tie. Then a Kelly forceps is slipped under a loop of the purse-string suture opposite the ends to be tied and a bite is taken into the appendix just proximal to the constriction made by the tie which tied off the appendix. Now an artery forceps is placed across the appendix just distal to the tie and amputation is consummated between the tie and the distal forceps either with an electrocautery or a knife followed by phenol and alcohol. The purse-string suture is tied by the surgeon while the assistant uses the Kelly forceps,

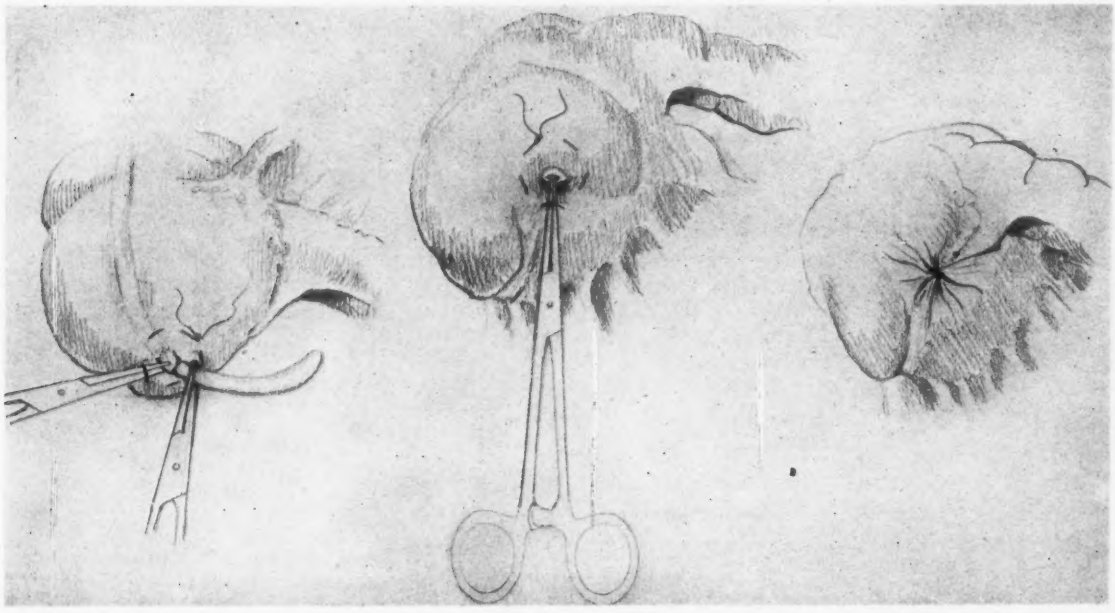

FIG. 1. FIG. 2. FIG. 3.
FIGS. 1 TO 3. Illustrating an improved method of inverting the appendiceal stump.

with its grasp on the stump as described, to complete the inversion. More stitches may be added at the discretion of the surgeon.

This method is simple, time-saving, and absolutely positive.

I wish to express my appreciation to Prof. Paul E. Barr, of the University of North Dakota, who made the drawings.

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An unnecessary appendectomy should not be done during an abdominal or pelvic operation which probably will be followed by some oozing of blood into the peritoneal cavity. A sump drain is routinely advisable if there is a possibility of postoperative oozing both to indicate the presence and amount of oozing and to keep the cavity free from blood and exudate.

From "Principles and Practice of Surgery" by W. Wayne Babcock (Lea & Febiger).

Case Reports

TRUE OXYCEPHALY WITH SYNDACTYLISM

CASE REPORT

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TRUE oxycephaly is an unusual and bizarre deformity of the skull. It is variously known as acrocephaly, dysostosis craniofacialis (Cruzon), and tower or steeple skull. Because of the frequent association of this condition with syndactylism of the four extremities it is also called acrocephalosyndactylia. Its rarity is attested by the fact that in 1938 Valentin[1] was able to collect only eighty-three authentic cases from the world's literature; he added seven of his own.

CASE REPORT

CASE NO. P1727.* The patient, a twelve year old white male, was first seen at the age of five. He was a spontaneous, term delivery. Deformities of both hands, feet and skull were noted at birth. His early development ran an average course; the first tooth erupted at the age of six months; he sat up unaided at the same age, and he was able to talk at fifteen months. A marked speech impediment was noted at that time. His general health was good. The past medical history was essentially negative with the exception of pertussis.

The family history revealed no similar deformities on either the maternal or paternal branches. Four other children were living and normal in every respect. One granduncle on the maternal side had a supposedly congenital anomaly of the spine, the exact nature of which is unknown. Two distant cousins on the maternal branch, also, had four children blind since birth. There was no other evidence of congenital malformations in the family.

*Courtesy of Arthur Steindler, M.D., Department of Orthopaedic Surgery, The State University of Iowa Hospitals, Iowa City, Iowa.

The physical examination revealed a well developed and well nourished male of somewhat repulsive appearance. His disposition was friendly and co-operative. He had a marked nasal quality of his speech, which made it difficult to understand him. The Binet I.Q. test was 49, the mental age being six.

The skull was broad in the parietal diameter, and tapered upward in the frontal region. The eyes were widely separated and obliquely set. They bulged prominently. (Fig. 1A.) The ophthalmologic examination showed a convergent squint, postpapillitic atrophy, and defective vision bilaterally. The conjunctiva, especially the palpebral, was hyperemic. Continual tearing was present.

The patient had a chronic nasal discharge and experienced difficulty breathing through his nose. The septum was very irregular with deviation to the left. The mouth was small ("fish mouth"), and the mandible protruded. (Fig. 1A and C.) The hard palate was very narrow and highly arched, associated with malocclusion. (Fig. 1B.)

The skeletal examination revealed prominence of the acromial end of the clavicle bilaterally. Abduction of the shoulder joints was limited to forty-five degrees; at this point the scapula rotated. He was unable to elevate the arms. There was no limitation of internal or external rotation. Extension of the elbow joints was limited to one hundred seventy degrees. Flexion was free. No restriction of pronation was present, but supination was limited to thirty degrees. The wrist, hip, knee and ankle joints showed no abnormalities.

There was total syndactylism of all five rays of the right hand. On the left the thumb was free, but the remaining fingers were syndactylic. Gigantism of the second and third rays bilaterally was also present. (Fig. 2A.) He was

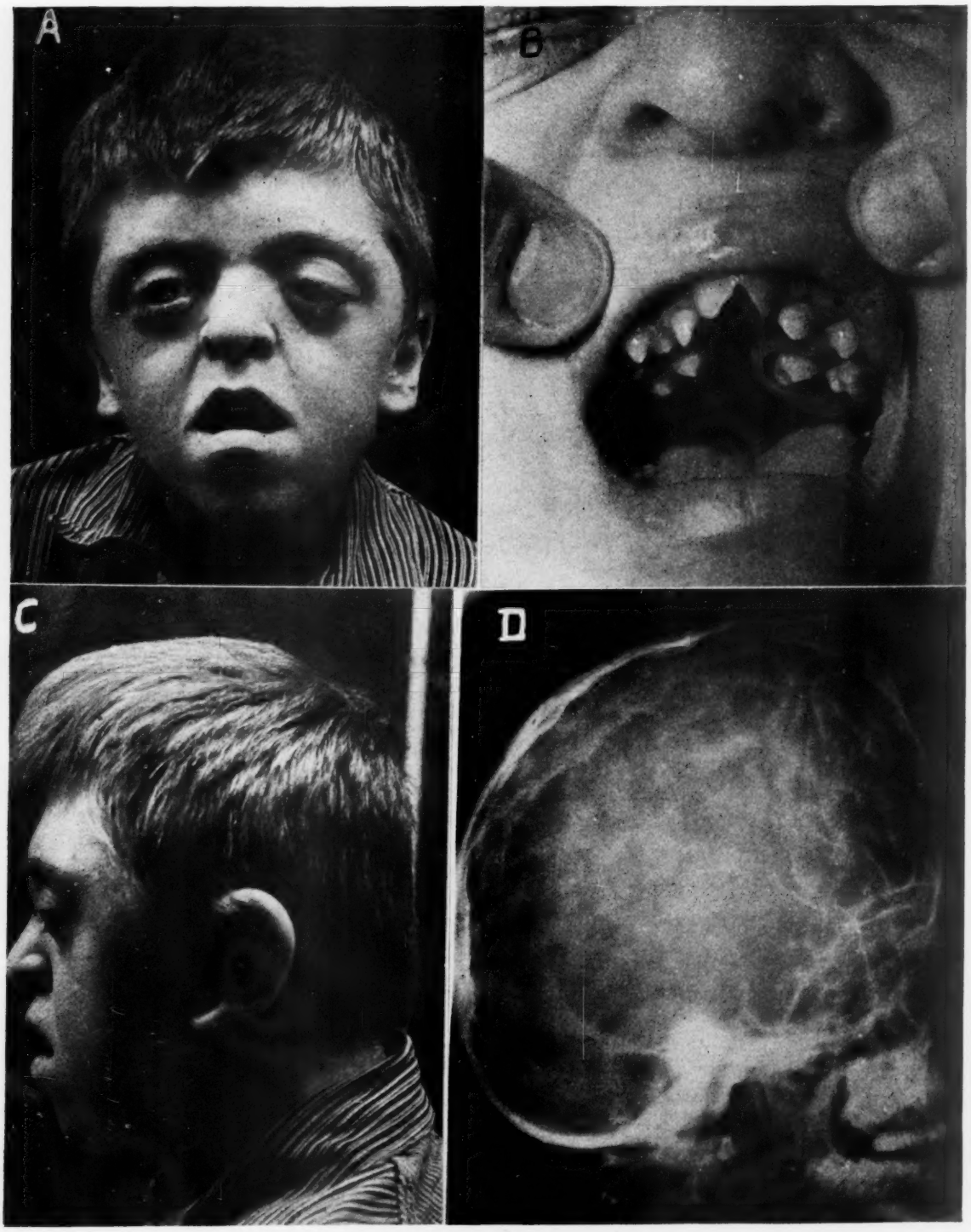

FIG. 1. A, full view of patient. See text for description. B, view of mouth showing very narrow, highly arched hard palate and malocclusion of teeth. C, profile view. D, lateral roentgenographic view of skull.

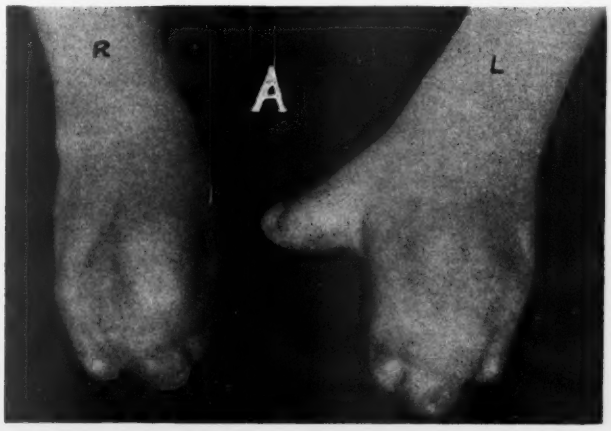

FIG. 2. A, photograph of hands showing syndactylism. B, roentgenogram of both hands. C, appearance of hands after surgical procedures.

able to use his hands quite well for coarse movement. He had somewhat limited motion of the interphalangeal joints.

Both shoulder joints possessed symmetrical malformations. The humeral head appeared flattened with squareness of the lateral margin.

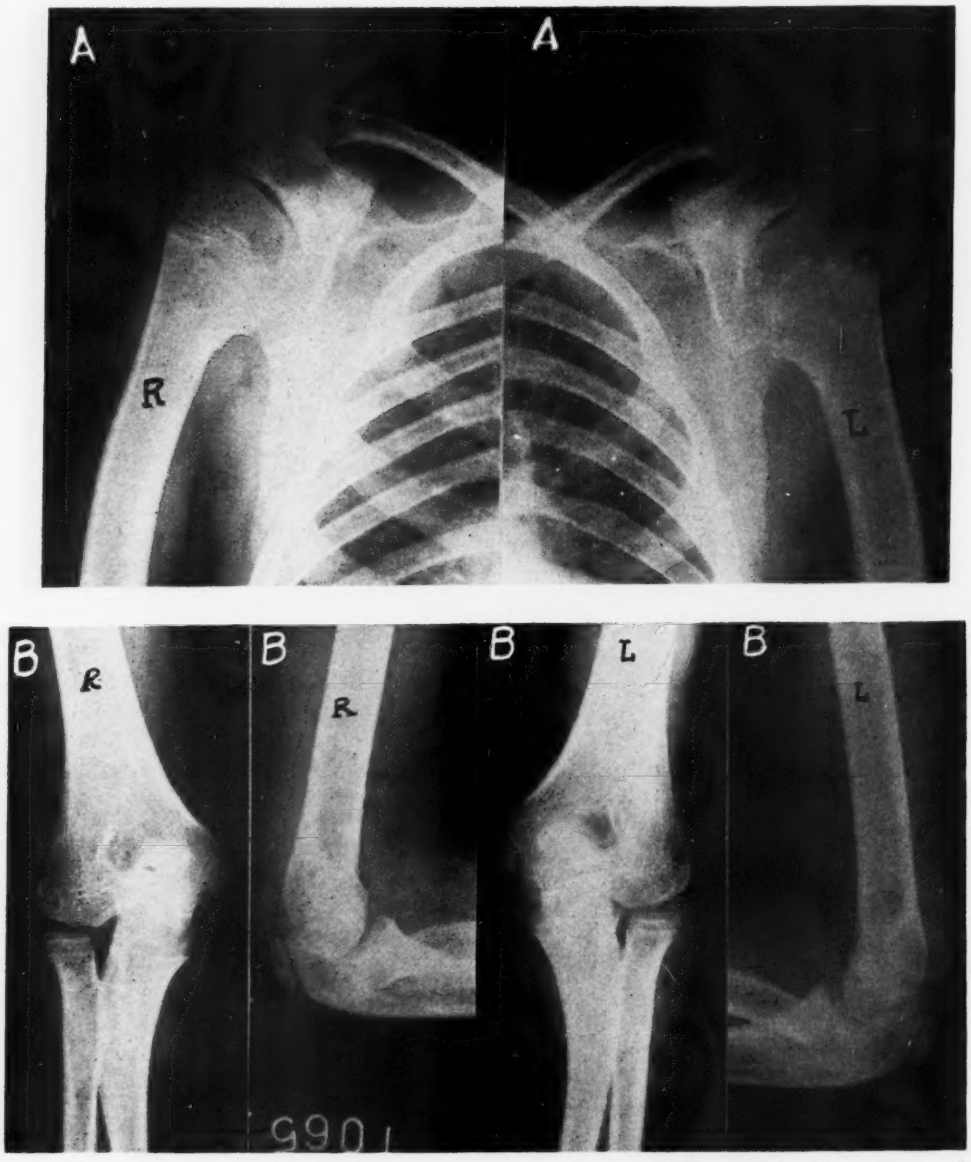

FIG. 3. A, roentgenograms of shoulder joints. B, roentgenograms of elbow joints. Note abnormal curvature of radius and ulna.

The toes were likewise syndactylic, involving all rays. Besides symmetrical syndactylism, gigantism of both first toes was observed. (Fig. 4C.)

Roentgenographically, the lateral view of the skull evinced the typical tower shape. The entire skull had a "beaten silver" appearance. The orbital fossa was very shallow. The sella was markedly enlarged, but showed no evidence of erosion or pathologic changes of the clinoid processes. The prognathism of the mandible was clearly shown. (Fig. 1D.)

The acromial process of the scapula was very large. (Fig. 3A.) Although the elbow joints were essentially normal, there was abnormal bowing of both the radius and ulna which accounted for the limitation of supination noted clinically. (Fig. 3B.)

Synostosis of the proximal portion of the fourth and fifth metacarpals of both hands was present. The fifth finger possessed three phalanges bilaterally. The third and fourth proximal phalanges showed synostosis at the distal ends. This fusion was capped by a large

triangular bony mass which probably represented an attempt at fusion of the mid- and distal phalanges. The index fingers also had and second metatarsals with gigantism of the first ray was noted. The remaining metatarsals were essentially normal. The first toe consisted

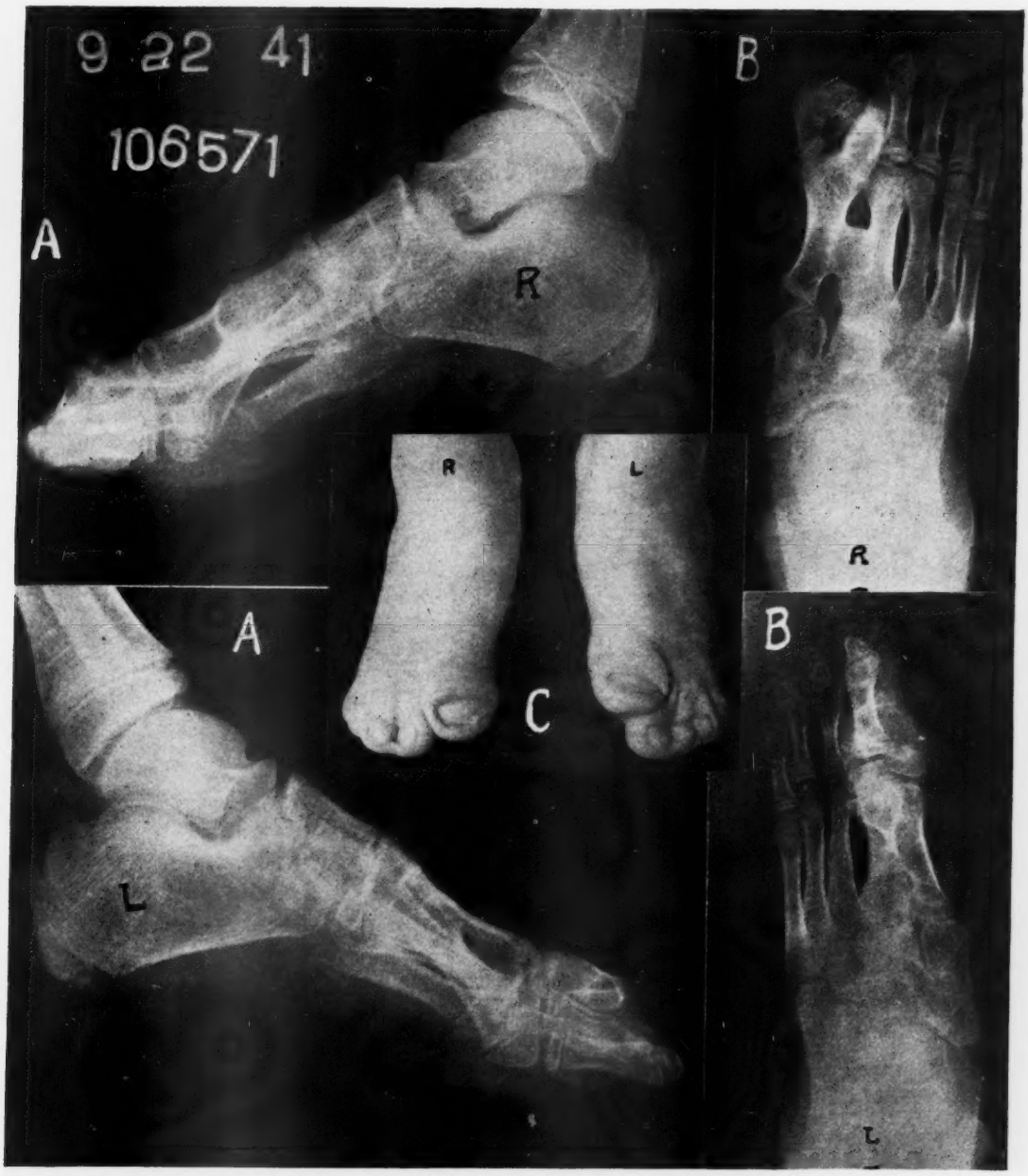

FIG. 4. A, lateral roentgenographic views of both feet. B, anteroposterior roentgenographic views of feet. C, photograph of feet showing syndactylism and gigantism of first toe.

symmetrical deformities; they consisted of but two phalanges. The first metacarpals were essentially normal. The corresponding phalanges, however, were markedly distorted. (Fig. 2B.)

Roentgenograms of the feet revealed similar deformities of the tarsus, metatarsus and phalanges. With the exceptions of the talus and calcaneus the tarsal bones were more or less fused into one mass. Synostosis of the first of one large triangular mass of bone which appeared to have an epiphyseal line. The remaining toes possessed two phalanges each, a long proximal and a very small distal segment. (Fig. 4A and B.)

The anteroposterior view of the lumbar spine and pelvis showed sacralization of the fifth lumbar segment, associated with spina bifida occulta. Wide diastasis of the symphysis pubis was present.

COMMENT

The case recorded presents all the essential features of true oxycephaly, namely, the configuration of the skull, the disproportion between the maxilla and mandible, the narrow highly arched palate, the small mouth, and the frequently associated syndactylism of all four extremities. True oxycephaly is not constantly associated with syndactylism, which, when present, may vary in degree and extent. Syndactylism occurs sufficiently often, however, so that the association cannot be entirely fortuitous. The larger joints, as manifested in this case, may also be affected.

Probably because of the bizarre appearance of these individuals, true oxycephaly was known to the ancients. Thersites[2] in the Iliad was an oxycephalic. According to Bertolotti,[3] Oribasius was cognizant of this deformity. The oldest clinical description is found in the case of Lycosthenes[4] (1557). Apert[5] (1906) was the first to point out the frequent association of syndactylism with the skull deformity. He coined the term "acrocephalosyndactylia."

The deformity is said to occur as an isolated instance, as in the case reported. Greig[6] states that "several cases of transmission from a parent to one or more of the children have been recorded, but no case of transmission to the third generation has been observed." Valentin,[1] on the other hand, writes "so far the world literature has not presented a single case of pure acrocephalosyndactylism in which heredity or familial occurrence of exactly the same malformation has been described."

The modus operandi of the skull malformation is an unexplained disturbance during embryonic life. The sutures become fused, and the rapidity of brain growth during the intrauterine period and early infancy produces the peculiar configuration. The facial bones are also involved by the premature synostosis.

The synostosis of the skull sutures gives rise to the secondary malformations, such as the shallow orbital fossae, the characteristic palate, stenosis of the large foramen of the skull, especially the optic and jugular, and the convolutional markings of the skull, the so-called "beaten silver" appearance. The latter finding, however, is not pathognomonic of oxycephaly; it may be found in other conditions.

The shallow orbital fossae cause bulging of the eyes. The bulging may become so marked that spontaneous dislocation of the eyeball may occur, as reported by Sherne.[7] Papillo-edema or even optic atrophy, which is a constant late feature, is present. Dyson[8] suggests that these symptoms may be explained upon the basis of kinking or pressure on the optic nerve by the narrowed foramen with consequent venous congestion and atrophy. Neurosurgical procedures have recently been attempted to relieve the failing vision or threatened blindness with some measure of success.[9,10,11]

The mentality is usually affected, as manifested by the mental age of six in the case presented. It is readily appreciated that premature closure of the cranial sutures does not permit the normal growth of the brain to take place.

True oxycephaly must be differentiated from acquired or false oxycephaly, a distinction not frequently made in the literature. The distinguishing clinical characteristics have been emphasized by Greig.[6] In false oxycephaly the synostosis is limited to one or at most only a few of the cranial sutures; the facial bones are never involved; associated deformities are not present, and the base of the skull is not affected. In true oxycephaly the apex of the height of the head is at or near the bregma; in false oxycephaly the head height shows a much greater variation, in many cases being located at the posterior part of the skull.

The syndactylism when extensive or complete, is amenable to surgery. Operative treatment offers not only cosmetic but also functional improvement. The case presented was beneficially aided by Pieri Z plasties, full thickness grafts and resection of the fourth ray and finger. (Fig. 2C.)

Care must be exercised in outlining operative therapy to ascertain, if possible, whether any congenital deficiency of the tendons or intrinsic musculature is present. It is preferable to have web fingers which function as a whole rather than to isolate a finger only to find that the patient is unable to flex it.

SUMMARY

A case of true oxycephaly associated with syndactylism of the four extremities and other malformations is presented. The features of this unusual congenital aberration and the differentiation from false oxycephaly are discussed.

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AIR EMBOLISM IN OBSTETRICS AND GYNECOLOGY*

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AIR embolism is a medical catastrophe. As early as 1667 Ride produced death in cattle by blowing air under pressure into their jugular veins. Beauchesne, in 1818, during the removal of a neck tumor observed the first recorded case of air embolism in the human.

There are two types of embolism—the venous and the arterial. In the venous air embolism air enters the peripheral veins and flows by means of the vena cava to the right heart and thence to the pulmonary arteries. In arterial embolism the site of entry is the pulmonary vein whence the air passes from the left ventricle to the systemic circulation and the brain.

There is no agreement as to the amount of air which constitutes a fatal dose. Rabbits will die after the rapid injection of 10 cc. of air into an ear vein. In 1937, Richardson, Coles and Hall, basing their inferences on experimental air embolisms produced in small animals, estimated that about 500 cc. of air would be required to kill a human being. Moreover, there is no constancy in the amount required even in individuals of the same species.

The prerequisites for the development of an air embolus are: (1) a vessel which is in a state of incomplete collapse, either because its wall is only partly opened, or because fascial attachments prevent its retraction, and (2) suction produced by negative venous pressure or else the introduction of air under positive pressure into the circulation.

These conditions are satisfied during many therapeutic procedures. Among the most common are the establishment and maintenance of pneumothorax, pneumonectomy, lobectomy, thyroidectomy, radical breast amputation, puncture of the paranasal sinuses, fractures of the long bones, continuous intravenous injections, perirenal insufflation, introduction of air into a joint cavity or the bladder; and of more interest to obstetricians, the induction of abortion, manipulation of the pregnant and puerperal uterus and, lastly, tubal insufflation.

The presence of air embolism is recognized by sudden shock, dyspnea, and cyanosis. If air is in the large veins, hissing sounds may be heard and bruits or churning noises are heard over the heart area. If air escapes into the arterial circulation, there is blindness. This is caused by air in the retinal vessels and may readily be seen by the ophthalmoscope. There may also be areas of skin blanching due to interference with the capillary circulation. Death may be instantaneous or may occur within several hours. About 15 to 50 per cent of the cases end fatally. If the patient survives the first fifteen minutes, the prognosis is good; if she survives the first hour, coma and paralyses clear.

There is no uniformity of opinion as to the mode of death. The common theories state that the non-compressible air replaces the compressible blood in the right heart, thus causing cardiac standstill. This alone, or obstruction in the pulmonary bed by air prevents the transfer of oxygenated blood from the right ventricle to the left auricle. Other theories postulate that coronary artery embolism is the cause of death, while others state that the ischemia of the vital brain centers produces the fatal result.

In a case of suspected air embolism it is necessary to ligate the great vessels before

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removing the heart and then to open the heart under water at which time the emboli are released.

A knowledge of the pathological anatomy leads to rational, but often ineffectual therapy. Artificial resuscitation is given, cardiac and respiratory stimulants are administered. Inhalations of 90 to 100 per cent oxygen facilitate the absorption of nitrogen bubbles in the circulation. Aspiration of the right ventricle has been attempted, and in an attempt to replace the frothy mass of air and blood in the right ventricle 50 to 100 cc. of saline solution have been injected.

Air embolism is of especial interest to obstetricians and gynecologists. In 1829, Legallois first suggested that air might enter the circulation by way of the uterine veins. Cormack, in 1850, and May, in 1851, described the first cases of air embolism associated with pregnancy. Air embolism in obstetrics most commonly follows the induction of abortion by means of a syringe. This is especially true when a low-lying placenta provides venous sinuses for the ready introduction of air into the circulation. Placenta previa at term is occasionally associated with air embolism, especially when version is performed. Several patients have expired instantaneously as a central placenta previa was being ruptured to obtain a foot. Several deaths have followed the now outmoded use of an intrauterine douche. In 1938, Osborn and Dawson described two cases of air embolism. In their first patient a classical cesarean section was performed under gas-oxygen-ether anesthesia for cephalopelvic disproportion. There is no mention of the location of the placenta, but at the time of the uterine incision the patient suddenly went into shock and three hours afterwards died. Autopsy revealed air bubbles in the right heart. Their second patient died abruptly. Two hours previously a spontaneous delivery had occurred. The conduct of the third stage is not mentioned. The autopsy revealed air in the right heart and, in addition, a uterus which was partially inverted with the fundus at the internal os.

Four deaths following tubal insufflation have been reported. The first two of these were recorded in 1927 by Moensch of the New York Post-Graduate Hospital. In the first case, an insufflation was followed by a curettage. Death occurred immediately. At postmortem, air was found in the right heart and the right femoral vein. In the second patient, a negress, sudden death followed a tubal insufflation. Air was found in the right heart, in the peritoneal cavity and, in addition, there was a small perforation of the intestines. Weitzman and Cohen, in 1937, reported a patient who died of multiple cerebral hemorrhages three days after an insufflation. The autopsy also revealed bilateral salpingitis with a dermoid cyst filled with air and adherent to the left tube. The fourth case was recorded by Dible in 1938. An insufflation was performed under open drop ether one day prior to the menses. Though the gas was heard to pass at 150 mm. of mercury, the patient became cyanotic and respirations ceased. For four minutes more the heart was heard to beat irregularly and feebly. The autopsy showed a recent corpus luteum in the ovary. The uterine vein was filled with air bubbles. The inferior vena cava, the right auricle, the right ventricle and the pulmonary artery were filled with frothy air.

Another case of interest was reported by Peirce. Death occurred during the vaginal insufflation for trichomonas in a twenty-six-year old primigravida who was four months pregnant. The autopsy revealed that the membranes were separated from the uterine wall by air which filled the uterine sinuses. The inferior vena cava was also filled with air. Two similar cases are reported by Brown and Partridge of fatal air embolism following vaginal insufflation for trichomonas vaginitis in the last weeks of pregnancy. These authors conclude that the danger of embolism increases as the placenta enlarges and as the cervical os becomes more patulous and,

hence, insufflation is contraindicated in the last months of pregnancy.

CASE REPORT

A twenty-eight year old nulliparous colored woman was admitted for tubal insufflation because of sterility of four years' duration. The general physical examination was normal; the pelvic examination revealed a marital outlet with a clean cervix; the uterus which was anterior, was normal in size; and the adnexae could not be outlined. Menses began at twelve years, occurred every twenty-eight days with a two to four day flow. On the twenty-first day of the menstrual cycle the patient was anesthetized with nitrous oxide and ether anesthesia. After the uterine cavity had been sounded at 9 cm. passage of gas at 80 to 100 mm. was heard on two occasions. Curettage was then performed; about ½ cc. of tissue grossly characteristic of secretory endometrium was obtained. At this time, about twenty minutes after the start of the operation, the anesthetist stated that the patient had difficulty in breathing. Examination revealed that the respirations had ceased and that only a feeble carotid pulse could be obtained. Resuscitation and stimulants were used without avail. Autopsy revealed a patent left tube, a stenosis in the outer third of the right tube about 2 cm. from the fimbriated end, a corpus luteum in the right ovary and 25 cc. of air in the right ventricle and pulmonary arteries. It was thought that either air was introduced at greater pressure than the operator realized, or that the curettage broke down the uterine sinuses and so permitted entry of air into the pulmonary circulation.

Rubin has always maintained that an insufflation should be performed only immediately after the completion of the menstrual period. However, sometimes in an effort to save time a patient is admitted for the simultaneous performance of insufflation and endometrial biopsy in the late premenstrual period. This is to be condemned for two reasons: (1) The performance of the insufflation at a stage when such great vascularity exists and, (2) the simultaneous curettage which may open up venous sinuses for the entrance of air.

CONCLUSIONS

1. A case of fatal air embolism following tubal insufflation is recorded. Four similar cases derived from the literature have been reviewed.

2. Because of the danger of air embolism, tubal insufflation should not be performed in the premenstrual phase, nor should a curettage be done simultaneously.

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SUPPURATIVE TYPHOID SPINE PERFORATING INTO THE BRONCHUS*

CASE REPORT

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WE wish to report an unusual case of suppurative typhoid spine which formed a paravertebral abscess and perforated into the lung. The length of the latent period, the confusing symptomatology and the efficaciousness of the treatment employed are of sufficient interest to make the case worthy of publication.

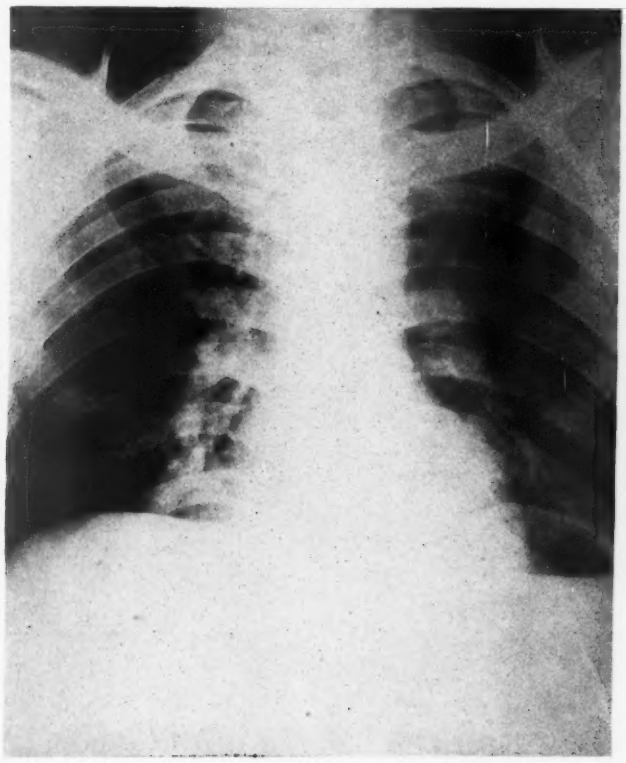

FIG. 1. Postero-anterior *x*-ray of chest showing an irregular density in the medial portion of the right lung.

CASE REPORT

W. P., a thirty-four year old colored male, was first seen in the Out-Patient Clinic with the chief complaints of intermittent lumbago and sciatica of ten years' duration. His symptoms were described as back pain and a pain that radiated down the back of his right leg. Physical examination revealed a slight limitation of back motion, a positive Lesague's sign of sciatica and a diminished right Achille's reflex. The patient's temperature was normal; a blood count showed a slight leukocytosis and a tuberculin patch test was positive. Blood and spinal fluid Wassermanns were negative. The colloidal gold curve of the spinal fluid indicated an inflammatory process. An anterio-posterior roentgenogram of the lower lumbar

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vertebrae and pelvis was normal. He was next seen two months later when he was admitted to the hospital.

Fig. 2. Anteroposterior *x*-ray of thoracolumbar vertebrae showing loss of details of bony architecture and osseous proliferation in the involved area.

Fig. 3. Right lateral *x*-ray of thoracolumbar vertebrae showing irregularities of the intervertebral spaces and wedging of the vertebral bodies.

The patient's interval history was one of increased back pain, fever, cough and lameness of the right leg. The fever and cough increased and soon the patient started to expectorate large amounts of purulent sputum which later became foul. A few days before admission two masses appeared on his back which progressively increased in size. The patient estimated that he had lost about fifty pounds of body weight.

The patient's past history was insignificant except for typhoid fever twenty-two years ago. There was no family history of tuberculosis.

The patient appeared acutely ill and frequently coughed up foul, purulent sputum. His temperature was 102°F. orally, pulse 120, respirations 32 and blood pressure 110/65. The patient disliked being moved during the examination because of the painful back and a complete examination was not done. The head and neck were normal. The percussion note was dull over the right chest posteriorly and many coarse râles and some rhonchi were heard in this region. The left lung and heart were normal. Two fluctuant masses, measuring four by ten inches, straddled the spine at the thoracolumbar junction. There was marked spasm of the back muscles and limitation of mobility of the spine, but the curvature of the vertebral column seemed normal. No tumors or tenderness were palpable in the abdomen, but a soft fluctuant mass was palpated in the right inguinal region. The right leg was maintained in a slight degree of internal rotation and semi-flexion, although it could be extended. The neurological reflexes of the legs were normal except for an absence of the right Achille's reflex.

The blood count showed a leukocytosis of 12,500 with 87 per cent polymorphonuclear leukocytes. The erythrocyte sedimentation rate was 117 mm. in an hour, the blood calcium and phosphorus were 11.4 and 4.0 mg. per cent, respectively, and the alkaline phosphatase was 2.8 B. units. The urinalysis was essentially negative. Repeated sputum examinations failed to reveal tubercle bacilli. Sputum cultures grew Streptococci viridans, Staphylococci aureus, colon bacilli and Neisseria catarrhalis.

A diagnosis of pulmonary tuberculosis, tuberculosis of the spine and psoas abscess was made on the patient's admission and he was transferred to the isolation ward.

A postero-anterior roentgenogram of the chest was interpreted as showing an irregular density extending from the second rib to the diaphragm in the medial portion of the right lung. In addition the vascular markings at the hilum were increased. The conclusion

was pneumonitis, tuberculosis unlikely, possibly foreign body in the right lower lobe. (Fig. 1.) Anteroposterior and right lateral roentgenograms of the vertebral column showed loss of details of the bony architecture of the lower thoracic and the upper lumbar spine, slight wedging of the vertebral bodies of thoracic eleven and twelve and lumbar one, narrowing of the intervertebral space between thoracic nine and ten and eleven and twelve, with an absence of the intervertebral space between thoracic twelve and lumbar one. The involved intervertebral spaces were hazy and ill defined, while the vertebrae in this region showed bony proliferation. The conclusion was spondylitis and hypertrophic arthritis of the thoracolumbar spine; specific etiology unknown, doubtful of tuberculosis, probably pyogenic. (Figs. 2 and 3.)

Bronchoscopy revealed an inflamed right lower lobe bronchus from which thick, foul, purulent material was aspirated. The specimen was sent to the bacteriology laboratory for examination. No foreign body, tumor or ulceration were seen. Aspiration of both fluctuant masses on the back yielded non-foul purulent material which was sent to the bacteriology laboratory for examination. A few cc. of methylene blue were injected into the abscess space of the left mass and within twenty-four hours the patient's sputum was stained the characteristic blue color.

The bacteriology laboratory reported the colon bacilli in the sputum as Eberthella typhosa. The bronchoscopy specimen showed mixed organisms including Eberthella typhosa. The specimens aspirated from the fluctuant masses on the patient's back yielded pure cultures of Eberthella typhosa. Sero-agglutinations of typhoid antigens O and H were significantly positive, while paratyphoid A and B were negative. All blood, stool and urine cultures were negative for the typhoid bacilli.

The diagnosis of tuberculosis was discarded and instead one of a suppurative typhoid spine with a bronchial fistula and paravertebral and psoas abscesses was made. The pneumonitis was associated with the bronchial fistula, the sciatica with the paravertebral abscess and the lameness of the right leg with the psoas abscess, all originating from the typhoid osteitis of the spine. (Fig. 4.)

The paravertebral abscesses were incised and drained; then dusted with sulfathiazole crystals and packed open with vaseline gauze. The patient was placed on a Bradford frame and given sulfathiazole orally with marked relief of toxic symptoms, although his blood

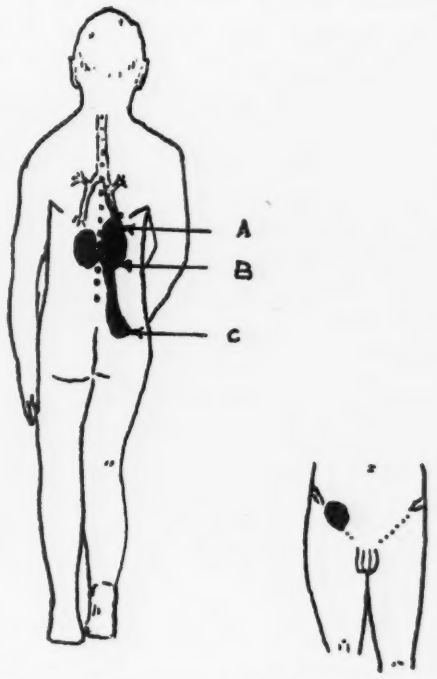

Fig. 4. Diagrammatic sketch which illustrates the regions involved. The typhoid spine abscess (A) perforated into the lung, (B) formed subcutaneous abscesses on the back and (C) extended along the psoas muscle to the groin. The smaller illustration shows the fluctuant mass in the inguinal region.

concentrations were only 2 to 3 mg. per cent. The patient rapidly improved and at the end of his second hospital month he was sent home. At the time of the discharge his wounds were well healed, the fluctuant mass in the right groin had disappeared and there was no pain even with back motion or bending over. The sciatica and lameness were not in evidence and he rarely coughed. Throat cultures were negative for typhoid bacilli, the erythrocyte sedimentation rate was 51 mm. in an hour and the temperature, pulse and respirations were normal.

The patient remained on a modified fracture bed at his home for a month and then was again seen in the Out-Patient Clinic. He had gained twenty pounds, was afebrile and had no back pain. He had no cough, the wounds remained well healed and the right Achille's reflex had become normal. The erythrocyte sedimentation rate had decreased to 37 mm. in an hour. A metal back supporting brace was ordered allowing the patient to become ambulatory.

During the following four months the patient wore his back supporting brace and was entirely asymptomatic. His erythrocyte sedimentation rate dropped to 22 mm. in an hour and he gained an additional twenty-five pounds of body weight. Roentgenograms of the chest and spine showed some improvement, but not in proportion to his clinical course.

The patient has now been followed for two years with progressive improvement of his health. He has gained seventy pounds and his erythrocyte sedimentation rate has returned to normal. He has been working for the past sixteen months and has been without his brace for seventeen months.

A long discussion regarding typhoid spine could be given, but the lowered incidence of typhoid fever and the rare occurrence of typhoid spine hardly make it necessary. Excellent publications by Murphy,[5] Freedman,[1] and McMaster[4] cover the subject fully. The interesting cases of Turner,[6] Wagenfeld,[7] Freedman, Guede and Arnous[2] and Keen (Case No. 17)[3] illustrate the complications of typhoid spine when suppuration occurs.

In conclusion, we should like to stress some of the unusual features of the case reported. The latent period, the interval between typhoid fever and the occurrence of the typhoid spine, varies from a few months to several years. Freedman quoted Puhl's case of having a ten-year latent period, while in the case reported it was twelve years before any symptoms occurred and twenty-two years before suppuration commenced. A suppurative typhoid spine is rare, but of even greater rarity was the extension of the suppurative process into the bronchus, subcutaneously on the back and into the pelvis in the form of a psoas abscess. Several of the cases quoted had pelvic or posterior subcutaneous extensions of the paravertebral abscess, but none perforated into the bronchus or lung. Another interesting point was the marked cessation of toxic symptoms when treatment was started. The incision and drainage of the abscesses was helpful, but certainly inadequate considering such an extensive area involved; while the immobilization and bed rest were too short to receive full credit. We believe that the employment of sulfathiazole, even though the blood concentration was low, was responsible for the early cessation of toxic symptoms. And lastly, we believe the patient in the case reported was saved from a diagnosis of tuberculosis of the spine by the tenacity of the bacteriologist who refused to believe the presence of colon bacilli in the sputum was accidental.

We wish to express our appreciation to Dr. V. A. Dodd, Chief of Staff, Starling-Loving Hospital, for granting permission to report this case.

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MASSIVE DELAYED HEMORRHAGE FOLLOWING TRAUMATIC RUPTURE OF SPLEEN AS A COMPLICATION OF FULL TERM PREGNANCY*

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WAUGH and Prior[1] have just recently reported two cases of traumatic rupture of the spleen with delayed hemorrhage as a complication of rib fractures. They stress the fact that delayed hemorrhage is an unusual and extremely dangerous complication of splenic injury. McIndoe,[2] in 1932, reported forty-six cases of delayed splenic hemorrhage, including one of his own, and stated that "the syndrome of delayed hemorrhage following splenic rupture is definite and should include only those cases in which the primary rupture is followed by complete, or almost complete hemostasis for a latent period of more than forty-eight hours, and then a delayed hemorrhage of dramatic onset and fulminating character."

In this communication, we desire to report a case of massive delayed hemorrhage following splenic injury which occurred as a complication of full term pregnancy. No fracture of the ribs was noted in our case. In 1943, Waugh and Prior added twenty-four cases of delayed splenic hemorrhage including two of their own to McIndoes' reported series of forty-six. Inclusion of this case would bring the total reported cases of delayed splenic hemorrhage to seventy-one.

McIndoe also voiced the opinion that patients should be excluded who gradually sink under the influence of a slowly progressing splenic hemorrhage, even though the duration of symptoms is more than forty-eight hours. The patient in this report carried on her normal daily activities for seven days following the injury, in spite of being in the latter part of the last trimester of pregnancy. Acute upper abdominal symptoms occurred on the seventh day, and resulted in her being hospitalized and splenectomy performed by one of us (C. I.) for acute hemorrhagic shock within eight hours after onset of the acute signs.

Of the seventy cases reported prior to this, only eighteen (or 26 per cent) had fractured ribs. As this addition to the series was a complication of a full term pregnancy, with no injury to the ribs, following an automobile accident, the percentage associated with rib fractures is reduced to 25 per cent. As far as can be determined from an analysis of the previously reported cases and a critical review of the literature since, this is the first case of delayed hemorrhage following traumatic rupture of the spleen occurring as a complication of pregnancy, that has been reported in the literature.

CASE REPORT

G. S., a twenty-seven year old white female, was seen on the afternoon of July 21, 1943, by one of us (G. E.) after an automobile accident with no apparent injuries. She returned to the office the following afternoon complaining of

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slight pain in her left shoulder. Complete physical examination revealed no positive findings and no apparent fracture or dislocation of shoulder girdle. Fetal heart tones were normal. She was next seen on July 27th, and stated that the left shoulder pain was more severe, but otherwise she felt fine. An *x*-ray of the shoulder and chest was negative.

Her sister telephoned about 2:00 P.M. on July 29th, stating that the patient was not feeling well and was troubled by bloating, belching and fullness in the upper abdomen, which she thought was similar to previous attacks of gallbladder dyspepsia. The patient entered the hospital at 7:45 P.M. that evening, complaining of a very severe pain in the left shoulder in addition to weakness, shortness of breath and pain in the epigastrium. All previous examinations had revealed normal pulse and normal fetal heart tones. At this time, the patient was pale, apprehensive and very thirsty. The temperature was 97.6°F., pulse 144, and respiration 24. Examination revealed a distended abdomen with the fundus of a full term uterus just short of the ziphoid process, marked epigastric tenderness, dullness in flanks, diminished peristaltic sounds and a fetal heart rate which was very faint and almost uncountable. The red blood count revealed 1,370,000 cells with 5.6 Gm. of hemoglobin. The white blood count was 3,450. The urine was essentially negative. The diagnosis of acute hemorrhagic shock was obvious and immediate exploratory laparotomy advised, with rupture of the spleen as a likely etiologic factor, especially in view of the progressive left shoulder pain followed by acute onset of upper abdominal symptoms.

At 12:40 A.M. on July 30, 1943, under cyclopropane anesthesia the abdomen was opened through an upper left rectus hockey stick incision. The patient had received 250 cc. of plasma and 1,000 cc. of physiologic saline intravenously preoperatively and was receiving 600 cc. of whole blood from her husband as the incision was made. Her pulse was 120 and blood pressure 100/72 at this time. On opening the peritoneal cavity, dark red blood gushed forth over the fundus of the uterus. Approximately two quarts of blood, including clots, was salvaged, mixed with citrate and strained for possible use. After aspiration of blood and clots, the small residual space left in the upper abdomen and containing most of the gastrointestinal tract was packed off. Direct vision was not feasible when hands were in the operative field due to the small space between the fundus of the uterus and the lower costal margin. Therefore, with fingers of the left hand around the splenic pedicle to control further bleeding, the spleen was explored with the right, revealing an organ enlarged about two times its normal size with a large blood clot covering a transverse fracture of the convex surface. With the source of the bleeding verified, the pedicle was doubly clamped and ligated in the usual manner and the spleen removed. No further bleeding was noted, and the abdomen was closed in layers without drainage with interrupted braided silk in fascia. The patient's general condition seemed better, with a pulse of 100 and blood pressure of 120/80 at the close of the operation. She had been receiving only oxygen, continuously since the fascia had been approximated and this was continued postoperatively, supplemented by blood transfusions and gastric suction. The fetal heart tones at this time were still very rapid.

The patient's general condition remained precarious postoperatively, but signs of further bleeding were absent. Fetal heart tones slowed to 180 per minute after another transfusion and intravenous fluids. However, ten hours postoperatively, the patient began to complain of severe lower abdominal pain. Uterine contractions continued intermittently and thirty-two hours postoperatively a stillbirth female child was delivered by B.F.D. with low forceps and episiotomy with relative ease in a primipara. The patient developed a patchy type of atelectasis, which responded to carbon dioxide therapy and percussion interscapularly over the main bronchi, three days postpartum and five days postoperatively. The patient had an uneventful convalescence after the fourth postpartum and sixth postoperative day with pulse, temperature and respiration within normal limits. She was discharged on the twelfth postoperative day entirely healed and feeling well. Her red blood count after four whole blood transfusions was 4,430,000 with a hemoglobin of 12.3 Gm., and a white blood count of 35,000.

The pathologic report was traumatic laceration of spleen. A laceration of the convex surface extending into the pulp and covered by dark red blood clots was noted at the junction

of the upper and middle third and extended transversely across the entire convexity. The lower pole contained tiny subcapsular fibromas. The cut surface revealed several small and large hematomas in the pulp.

COMMENT

Waugh and Prior[1] state that delayed hemorrhage is an unusual and extremely dangerous complication of splenic injury. The above entity, a serious condition in its own right, may be complicated by other trauma or occur as a complication of other injuries such as fractured ribs or other normal conditions such as pregnancy. This patient was eight and one-half months pregnant at the time of splenic injury and at the time of surgery was in the latter third of the last trimester. The tremendous space filling ability of an almost full term uterus, undoubtedly, had a tremendous influence on the patient's favorable outcome, because of its effective tamponade on the wide open splenic venous sinuses by diminishing the size of the peritoneal cavity. Following the principle of Boyle's law relative to pressure changes of liquids in closed spaces when subjected to a decreased volume and in view of the low preoperative red blood count (1,370,000), it is doubtful if the patient would have survived to the time of operation if she had not been pregnant.

The postoperative red blood count in Waugh and Prior's[1] two cases took nineteen and twenty-two days, respectively, before reaching a 4,000,000 or higher level in spite of transfusion. This patient had a 4,430,000 red blood count with 12.3 Gm. of hemoglobin on the sixth postoperative and fourth postpartum day with three transfusions of 500 cc. of blood. The uterus, apparently, played the rôle of dual benefactor, not only by limiting the size of the space bled into, but also by autotransfusion of uterine blood thirty-two hours postoperatively after delivery of a stillbirth female infant. The patient lost less than three ounces of blood during delivery and it has been estimated that from 500 to 800 cc. of blood are reintroduced into the general circulation after the uterus firmly contracts down.

Delayed splenic hemorrhage is a definite complication of fractures of the ribs, especially on the left side. McIndoes'[2] series of forty-six were accompanied by ten fractures, having a total incidence of eighteen complicating rib fractures, or 26 per cent. No fracture of ribs was apparent in our case either by *x*-ray, physical signs or symptomatically. Waugh and Prior emphasize the frequent association of rib fractures in delayed splenic hemorrhage (25 per cent) and stress the fact that because of the more important and apparent abdominal symptoms, rib fractures may be overlooked, especially if asymptomatic. Much more important is the maxim that delayed splenic hemorrhage may go on to a fatality unnoticed in patients with rib fractures on the left side. Accordingly, in fractures of the lower right ribs, lacerations of the liver with immediate or delayed hemorrhage should be suspected until ruled out. Hinton and Steiner[3] in 279 cases of fractures of the ribs sufficient to warrant hospitalization, report twenty-nine fatalities or 10.4 per cent. Of the twenty-nine deaths only two were attributed to delayed splenic hemorrhage. Therefore, we wish to reemphasize the importance of the possibility of intra-abdominal injury occurring with fractures of the lower ribs. This is in view of the well known anatomical fact that the dome of the diaphragm rises to a level of the seventh and eighth ribs posteriorly, and fourth and fifth ribs anteriorly. In reality, the liver and spleen occupy the lower third of the thorax and are in juxtaposition to the ribs and thus very susceptible to any transmitted trauma to the bony thorax.

A snug Scultetus, many tailed, abdominal binder should be indicated as much preoperatively as intravenous blood transfusions so as to constrict the size of the peritoneal cavity. This was supplemented intra-abdominally in our case by the presence of a full term uterus.

Of the forty-six cases of delayed splenic hemorrhage reported by McIndoe[2] in 1932, seven patients died because of delay in operative interference. This high incidence is, undoubtedly, due to the fact that whole blood and plasma banks were not in vogue at that time. However, the availability of blood and plasma today should not be a legitimate reason for temporizing in acute splenic injury with hemorrhage as the peritoneal cavity will hold several quarts of blood. Every patient involved in an obvious clinical case of frank intra-abdominal hemorrhage should be operated upon immediately with blood and plasma started as one proceeds with the laparotomy. In doubtful cases every diagnostic procedure at hand should be utilized to reveal the presence of blood in the peritoneal cavity. Kehr's sign, or referred pain in the left shoulder, was present in our case with increasing severity from the second to the seventh day after the auto accident. Ballance's sign, consisting of increasing and non-shifting dullness in the splenic area and left lower quadrant of the abdomen and free fluid in the right lower quadrant, was also present during the last eight hours preoperatively. Wright and Prigot[4] recommend abdominal tap for free blood as a diagnostic aid and claim positive results in thirteen of the fifteen times it was used. This was not necessary in our case, but we believe that such a measure or a diagnostic peritoneoscopy may be indicated in possible splenic injuries. Peritoneoscopy is also indicated in perforating stab wounds of the abdomen or lower chest of doubtful nature, as recently reported by Hamilton and Duncan[5] in a series of traumatic cases. Immobility or elevation of the left diaphragm fluoroscopically, if present, is a valuable aid in diagnosis of subphrenic perisplenic hematoma.

The spleen has been definitely proven as not being essential to a normal lifetime and, therefore, splenectomy is obviously the therapy of choice in acute splenic hemorrhage. Any method short of this is contraindicated because of the possibility of delayed hemorrhage from the rupture of a intrasplenic hematoma and reactivation of hemorrhage by walking, bending, coughing or sneezing, as has been cited in the literature before. This did not occur in our case as far as can be determined, although the patient spent the entire day preceding the operation canning vegetables.

The use of free blood in peritoneal or pleural cavities for autotransfusion has been previously suggested. Blood in the peritoneal cavity complicated by perforations of the bowel, or blood in the pleural cavity accompanied by laceration of the lung parenchyma have been accepted as contaminated sufficiently not to warrant reintroduction into the patient's vascular system. Approximately, 1,200 cc. of blood were salvaged in our case by citration and straining; however, enough blood was available so that its use was not necessary. Hamilton and Duncan[5] stress the reinfusion of salvaged blood even though grossly contaminated by bowel perforations if needed as a life saving procedure. Using this method, the source of the bleeding can be stopped immediately and the vitally necessary whole blood salvaged and utilized in spite of inavailability of donors. This procedure, no doubt, will lead to some complications, such as bacteremia or septicemia; however, if thoroughly citrated, strained through gauze and introduced with 5 Gm. of sulfadiazine, it will probably save more lives than waiting for an available donor.

Postoperatively, our patient developed a typical patchy type of atelectasis of the left lower lobe with tachycardia, fever and cyanosis. After delivery (thirty-two hours postsplenectomy) the patchy process extended and involved in addition the entire right lung field. Carbon dioxide inhalations, postural drainage and manual percussion had no apparent effect until the fourth postpartum day when she had a severe coughing spell, raised two tablespoonsful of thick, tenacious sputum and cleared spontaneously, both clinically and

symptomatically, within twelve hours. Her convalescence thereafter was uneventful and the patient was discharged on the tenth postpartum day.

McIndoe's criteria for the definition of delayed hemorrhage following splenic rupture are reiterated here only to help emphasize the distinguishing features between it and a slowly progressing splenic hemorrhage in which the patient gradually sinks, although the duration of the symptoms is longer than forty-eight hours. The syndrome of delayed hemorrhage following splenic rupture is much more of a definite entity, with complete interruption of signs and symptoms both clinically and otherwise for more than forty-eight hours. Our patient carried on her normal activities for seven days after her automobile accident with sudden collapse on the seventh night.

The question arises as to the mechanism of death of the fetus, which was delivered in a primipara thirty-two hours postoperatively, with relative ease and supplemented by low forceps and episiotomy. Less than three ounces of blood were lost during the entire procedure. The patient's red blood count immediately preoperatively was 1,370,000 cells. On the day between splenectomy and delivery, the red count was 2,600,000 with 8 Gm. of hemoglobin. On the second postpartum day it was 3,150,000 with 9.9 Gm. of hemoglobin. It seems probable that during the period of twelve to twenty-four hours while the red blood count was less than 2,000,000 cells, severe cerebral anoxia was, undoubtedly, present to a greater or lesser degree. Although this was tolerated well by the patient, and was supplemented by oxygen during operation and by nasal catheter postoperatively, the fetus' vital centers could have suffered irreparable damage during the several hours preoperative when no supplemental oxygen was being administered. At the time of operation, cesarean section was not deemed advisable due to the patient's condition. It was thought that cesarean section would be more dangerous to the mother than would delay be to the fetus. It seemed reasonable to assume that with the bleeding controlled and with supplemental whole blood and oxygen, the fetal tachycardia would disappear. This it did during the next ten hours, although after this it gradually returned, accompanied by intermittent uterine contractions. Lutein and Pantapon were given. Delivery occurred thirty-two hours postoperatively.

The fetal heart rate remained consistently around 180 per minute, which is considerably above the normal range of 120 to 160 beats per minute. However, we frequently have seen the heart rate as fast as 180 or slower than 100 during labor in which the fetus was delivered, resuscitated without difficulty, and remained perfectly normal.

The diagnosis of ruptured spleen was not made until after the patient had suffered a very considerable hemorrhage and was in a state of shock. In spite of the slight possibility of being able to save the baby's life by doing a cesarean section at the time of the splenectomy, we elected to allow the patient to deliver from below in order not to increase the shock. The baby was alive at the time of the operation but apparently died within eight hours afterward. The cause of the fetal death is a question for speculation and it was our opinion that the cause of death was the very marked anemia of the mother, providing insufficient oxygen to maintain the fetus.

We were very much concerned as to the effects of labor on a patient having recently undergone a major operation. However, as has been noted in numerous other serious conditions complicating pregnancy at term, the labor was very easy. Dilatation of the cervix was accomplished within about four hours after onset of uterine pains. The patient was then transferred to the delivery room and a stillbirth female infant delivered very easily with low forceps, using light cyclopropane anesthesia. As has been noted, the blood loss was minimal.

Following the delivery, the patient seemed to be in good condition and was given another transfusion. About four hours later she became cyanotic, developed persistent coughing, and complained of pain in the chest. The physical findings were those of massive patchy atelectasis of the right lung, also partial atelectasis on the left. The treatment and results have been previously cited.

SUMMARY

A case of massive delayed hemorrhage, following traumatic rupture of the spleen, occurring as a complication of full term pregnancy with survival of the mother is reported.

This case was unaccompanied by fracture of the ribs and brings to seventy-one the series of delayed splenic hemorrhage reported in the literature.

Of the seventy cases of delayed splenic hemorrhage officially reported, this is the first occurring as a complication of pregnancy.

The rapid rise of the patient's hemoglobin and red blood count postoperatively was attributed to the autotransfusion of uterine blood occurring after delivery.

The importance of early diagnosis and splenectomy in splenic injuries is re-emphasized.

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CHEMOTHERAPY IN FROSTBITE*

CASE REPORT

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THE use of allantoin-sulfanilamide ointment using a specially developed, non-greasy, water-miscible base in surgery was first reported by Veal and Klepser.[1–4] They found that repeated topical applications of powdered sulfonamides tended to retard healing. The granulation tissues became sluggish, pale and dried out in appearance. By microscopic section of the granulating bed they demonstrated pale staining nuclei in most cells and a marked lack of blood vessel formation. The problem of controlling infection and at the same time encouraging more lively granulating tissues was solved by substituting for the powdered sulfonamides a non-greasy, water-miscible base containing 10 per cent sulfanilamide, which proved adequate to control infection, and 2 per cent allantoin to stimulate healthy granulation tissues. They concluded: "Microscopic evidence of greatly increased vascularity and healing seems to justify the addition of this drug (allantoin) to sulfonamide therapy in certain instances."

Lockwood[5] had shown that necrotic tissue and pus contain sulfonamide inhibitors which interfere with the bacteriostatic action of sulfonamides. The inhibitor substances were inactivated according to Wallersteiner,[6] by combinations of sulfanilamide-urea, and sulfanilamide-allantoin. In a report, Holder and MacKay[7] presented the results of wound therapy with urea-sulfonamide mixtures, and stressed the removal by the urea of gross sulfonamide inhibitors, or the source of such inhibitors in the form of necrotic tissue and pus.

Chemical débridement by means of allantoin cleans the wound of those substances which tend to interfere with the bacteriostatic action of the sulfonamide, thus a suitable sulfonamide-allantoin combination not only frees the wound of the infectious process, but at the same time stimulates the growth of healthy granulation tissues.

Allantoin, as a stimulator of cell growth, was reported on by Macalister[8] who used extracts of comfrey root (which on chemical analysis were found to contain large percentages of allantoin) and pure allantoin solution, to treat indolent ulcers, which had failed to respond to all other types of therapy. His results convinced him of the efficacy of allantoin as a healing agent in these conditions.

The successful results obtained by Baer[9] in his maggot therapy, which were manifested by débridement of necrotic tissue and the rapidity of healing by the increase of healthy granulation tissues, was shown by Robinson[10] to be due to allantoin which was found in the excretions of maggots.

On the strength of the reports of Veal and Klepser[1–4] it was decided to try the allantoin-sulfanilamide ointment* in a case of severe frostbite of the right hand.

CASE REPORT

J. T., a white, fifty year old male, was admitted to the hospital on December 23, 1942, with severe frostbite of the right hand. He remained in the hospital until February 2, 1943. During his hospitalization, the right middle finger was amputated because of dry gangrene.

* Allantomide ointment was supplied by The National Drug Company, Philadelphia, Pa.

* Hahnemann Hospital, Philadelphia, Pa.

Due to very severe pains in the right hand, and areas of gangrene over the dorsal portion, the patient returned to the hospital on Febru-

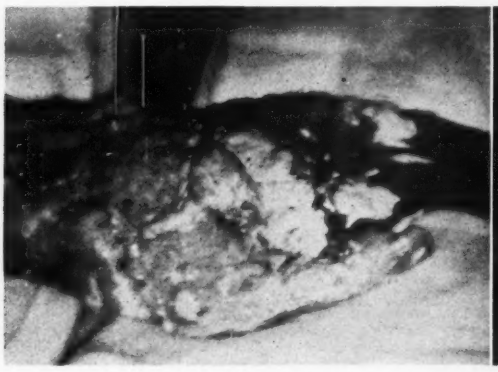

Fig. 1.

Fig. 2.

Fig. 1. Appearance of hand at start of allantoin-sulfanilamide ointment treatment (May 6, 1943).
Fig. 2. The gangrenous fingers sloughed off May 27th. Appearance of hand on June 24, 1943.

Fig. 3.

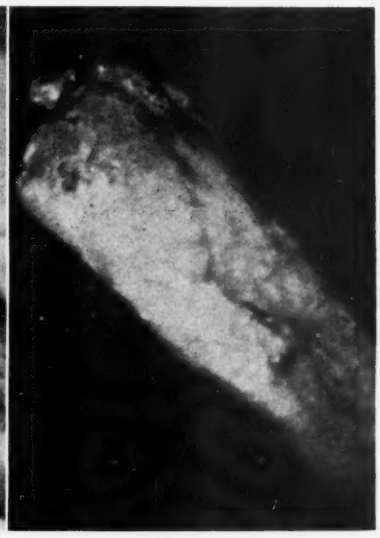

Fig. 4.

Fig. 3. Appearance of hand on August 28, 1943, with successful skin graft.
Fig. 4. Appearance of hand at time of discharge from hospital.

ary, 16, 1943. An *x*-ray examination on admission revealed the following: (1) Phalanges of little finger missing; (2) distal phalanx of second finger missing; (3) decalcification of carpal bones and proximal ends of metacarpal bones, and (4) considerable pus in the palmar area.

Wasserman and Kahn tests were negative.

Blood irradiation treatments were given on February 17th and 18th with no apparent benefit to the patient.

The patient was transferred to the department of surgery on February 25th. His temperature was 102°F. A continuous septic temperature persisted until April 3rd when it became normal and remained so until released.

For the relief of the severe pain, morphine ¼ gr. was ordered at night and continued until March 15th. Venous occlusion (intermittent), one minute on and two minutes off, was started immediately, and continued until June 25th.

Blood cultures taken on April 2nd were negative.

Because of the low red blood cell count, a transfusion of 500 cc. of citrated blood was given on May 6th, and allantoin-sulfanilamide ointment therapy started.

Figure 1 shows the condition of the hand at the time of starting allantoin-sulfanilamide ointment treatment. Although the fingers were gangrenous, and the palmar surface was covered with slough tissue, these were not disturbed. The ointment in a liberal amount was applied over the whole hand and wrist, and then

dressed with vaseline gauze and dry dressings. These dressings were changed after four days, the hand was gently bathed with hydrogen peroxide, and fresh ointment applied. Dressings were changed at four to five-day intervals, the hand being bathed at each dressing period with hydrogen peroxide to remove adherent ointment and loose slough tissues. On May 27th, all of the fingers sloughed off, and there was evidence of epithelization on the dorsal aspect of the hand. The thumb was folded under the site of the index finger and was attached. On June 10th, the palmar surface was completely sloughed and was trimmed to some degree with forceps and scissors. By June 24th, the palmar area was clean of all slough tissue, and epithelization was evident. (Fig. 2.)

It was decided on August 5th, that the hand was in good condition for skin graft. The skin graft operation was performed on August 16th, at which time the thumb was separated from the palm. Allantoin-sulfanilamide ointment with a light pressure dressing was applied. A change of dressing on August 28th revealed an excellent take of the graft. (Fig. 3.) The patient was discharged from the hospital on September 21st. (Fig. 4.)

During the whole course of the allantoin-sulfanilamide ointment treatment, laboratory tests for urine and blood sulfanilamide levels were made frequently. At no time during the treatment were sulfanilamide crystals found in the urine. Determination showed 2.4 mg. per cent sulfanilamide in the blood May 9th, and 2.3 mg. per cent on June 2nd. After venous occlusion treatment was discontinued (June 25th); blood determinations for sulfanilamide showed only traces of the drug.

SUMMARY AND CONCLUSION

A case of frostbite is presented. It is believed that the institution of the allantoin-sulfanilamide ointment treatment in the case reported was a big factor in saving the patient's hand. The ointment, by chemical débridement due to allantoin, completely cleansed the hand of sloughed and devitalized tissue and stimulated new granulation tissues and epithelium. Infection was definitely brought under control. The results obtained in this case indicate that allantoin-sulfanilamide ointment in a specially prepared, non-greasy, water-miscible base is worthy of a trial in the treatment of severe frostbite.

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SPASTIC CALCANEOCAVUS FOOT DEFORMITY*

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SPASTIC paraplegia generally produces an imbalance of the opposing muscles of the hip, knee or ankle with resultant deformities. Occasionally, however, the intrinsic muscles of the foot are involved producing a deformity which makes walking very difficult. Overstimulation of the medial and lateral plantar nerves produces a hyperactivity of the intrinsic muscles with marked flexion of the toes at the metatarsophalangeal joints and extension at the interphalangeal joints. This position may be correctible passively or it may be fixed and unable to be corrected manually. In the former type of case, a Stoeffel operation alone may succeed in re-establishing muscle balance and correcting the deformity. In the latter case of fixed contracture, however, tenotomy, capsulotomy, and muscle stripping will be necessary to correct the deformity. In addition, neurotomy of the motor branches of the medial and lateral plantar nerves will tend to re-establish muscle balance and thereby prevent a recurrence of the deformity.

The medial plantar nerve supplies the abductor hallucis, the flexor digitorum brevis, the flexor hallucis brevis and the first lumbrical. The lateral plantar nerve supplies the rest of the intrinsic muscles of the foot, its distribution being similar to that of the ulnar nerve in the hand. Section of the motor branches of the lateral plantar nerve will tend to correct the imbalance of all the toes except the great toe. In order to reduce the contracting action of the flexor hallucis brevis, its motor branch from the medial plantar nerve must be sectioned. The abductor hallucis tends to flex the proximal phalanx as well as abduct it. Its motor branch should also be sectioned. Fear of resultant muscle imbalance due to unopposed action of the antagonistic adductor hallucis is unwarranted, since this latter muscle is also deprived of its nerve supply by sectioning the deep motor branch of the lateral plantar nerve.

The case to be reported is one in which flexion contraction of all the toes was present with marked fixed flexion contracture of the great toe only. The fixed contracture was corrected by plantar capsulotomy at the metatarsophalangeal joint as well as tenotomy of the double insertion of the flexor hallucis brevis. Neurotomy of the motor branches of both plantar nerves was then performed. In view of the cavus deformity of the foot, a Steindler plantar stripping was also performed. The resultant cosmetic and functional improvement was gratifying.

CASE REPORT

G. C., male, aged twelve years, was first seen in the dispensary at Sydenham Hospital, in April, 1941. He presented a spastic paraplegia due to congenital lues. Both his mother and maternal grandmother were treated for lues. The birth history indicated a full term infant delivered normally. He talked at eight months and walked at thirteen months. He was well until the age of three years (1932) when he developed pain first in the right leg and shortly thereafter in the left leg. At the age of four years (1933) he was operated upon elsewhere for bilateral spastic pes equinus. Bilateral lengthening of the tendo-achilles was performed. Three years later (1936) similar procedures were again performed. Following each of these procedures, the patient's gait improved temporarily. In addition to the foot disability, he suffered from repeated epileptiform seizures.

When seen by me in 1941 the right foot presented a marked calcaneocavus deformity. In addition all the toes were in plantar flexion

* From the Orthopedic Services of Dr. J. Wishner and the late Dr. S. Jahss, Sydenham Hospital, New York, N. Y.

at the metatarsophalangeal joints with extension at the interphalangeal joints, i.e., intrinsic flexion deformity. The great toe was in flexion was due to shortened and taut flexor hallucis brevis as well as to a tight capsule. When an attempt was made to extend the toe

A

B

Fig. 1. A, lateral view before operation. Note marked plantar flexion at the metatarsophalangeal joints; also calcaneocavus deformity. B, anteroposterior view before operation. Note subluxation at metatarsophalangeal joints.

contracture position of about 45 degrees. With considerable force it could be extended only about 10 degrees passively, i.e., to a position of minus 35 degrees. The flexion contracture passively, a clonus was set up. The second toe could be extended passively to minus 5 degrees. Both great and second toes presented a plantar subluxation at the metatarsophalangeal

joints. The third, fourth and fifth toes could be extended completely passively. The plantar structures of the foot were markedly taut.

great and moderate plantar flexion of the second toes at the metatarsophalangeal joints. A calcaneocavus deformity was also noted.

A

A

FIG. 2. A, lateral view after operation. Note over-correction following tentotomy, capsulotomy and neurotomy. B, anteroposterior view after operation. Note correction of subluxations.

As the patient walked, he bore his weight on the heel and terminal ends of the flexed toes. The ball of the foot was elevated off the floor so that no weight was borne on the metatarsal heads. The gait was typically spastic and the toes scraped along the floor. The second toe overlapped the great toe.

X-rays of the right foot dated March 31, 1941, revealed marked plantar flexion of the

The patient was admitted to the hospital for section of the motor branches of the median and lateral plantar nerves; section of the flexor hallucis brevis insertion; plantar capsulotomy at the metatarsophalangeal joint of the great toe; and Steindler stripping of the os calcis.

1. On April 18, 1941, under tourniquet control, a 2½ inch longitudinal incision was

made along the medial aspect of the heel beginning at the posterior aspect of the heel and extending forward to the apex of the longitudinal arch of the foot. The skin and fascia were dissected from the undersurface of the plantar fascia. The medial border of the abductor hallucis muscle was dissected exposing the medial plantar nerve as it passes under cover of the muscle. By retracting the muscle plantarly, the nerve could be isolated and dissected free exposing the motor branches to the abductor hallucis, the flexor brevis digitorum, and the flexor brevis hallucis muscles. These nerve branches were identified by stimulating them with tissue forceps, producing a contraction of the muscles supplied by them. The nerve branches were then sectioned. The plantar fascia was then incised transversely close to its origin at the os calcis. The underlying abductor hallucis, flexor brevis digitorum and abductor digiti quinti muscles were then sectioned close to their attachment to the os calcis and stripped forward with a blunt elevator to the calcaneocuboid joint. The wound was then closed.

II. A 2¼ inch incision was then made along the medial aspect of the head of the first metatarsal, curving transversely into the plantar crease at the base of the big toe. The skin flap was retracted plantarly exposing the flexor hallucis longus tendon. By retracting this tendon, the two tendons of insertion of the flexor brevis hallucis were exposed as well as the capsule of the metatarsophalangeal joint. The flexor brevis tendons were sectioned and a plantar capsulotomy performed. The marked flexion deformity of the great toe could then be easily corrected. The wound was closed.

III. A 2¼ inch longitudinal incision was made on the plantar surface of the foot at the junction of the medial and lateral thirds of the foot. The incision began about ½ inch proximal to the level of the tuberosity of the fifth metatarsal bone and extended forward. The tuberosity of the fifth metatarsal bone marks approximately the level where the lateral plantar nerve divides into the superficial and deep branches. The incision was deepened bluntly between the flexor digitorum brevis and the abductor digiti quinti muscles, exposing the lateral plantar nerve in the depth of the wound.

The nerve was isolated and dissected exposing the deep and superficial branches as well as the proper digital branch of the superficial nerve. The latter supplies the flexor digiti quinti brevis and the two interossei of the fourth interspace. This was sectioned as well as the deep motor branch which supplies the remaining interossei, the adductor hallucis and the second, third and fourth lumbricales. The wound was closed and the remaining toes were manipulated. A plaster of Paris cast was then applied from the toes to below the knee with the ankle at 90 degrees and the toes in corrected position.

Following the operation, the patient had several epileptiform seizures which were controlled with luminal. Postoperative roentgenograms dated April 21, 1941, revealed complete correction of the flexion contractures at the metatarsophalangeal joints of the great and second toes. Some flexion was noted at the interphalangeal joint of the great toe. On May 1, 1941, the patient began to walk with crutches. On June 9th, the plaster cast was removed and a regular shoe applied. On June 16th, the patient was walking quite well without support. Posture of the foot was greatly improved and he was able to place the foot completely on the floor so that weight was borne on the metatarsal heads as well as on the heel. The patient was last seen on December 22, 1942. The correction of the right foot had been maintained and the patient was able to walk quite well. He was still troubled with epileptiform seizures, but between attacks he was able to get around satisfactorily.

SUMMARY

A case of intrinsic muscle imbalance of the foot due to spastic paralysis has been described. Although the patient presented a calcaneocavus deformity as well as marked flexion contracture at the metatarsophalangeal joints, it was the latter deformity which primarily caused his disability. Because of this, he was unable to bear his weight fully on the plantar aspect of the foot. This was corrected by tenotomy and capsulotomy, and recurrence of the deformity has been prevented by neurotomy of the motor branches of the median and lateral plantar nerves.

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DUODENAL ATRESIA IN THE NEWBORN

CASE REPORT

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IN a survey of the literature on any subject, one of the first obstacles encountered is the looseness in terminology used in describing certain conditions. The term "intestinal obstruction" is used to designate the blocking or clogging of the lumen of the intestinal tract which hinders the passage of its contents. Such terms as atresia, occlusion, stenosis and aplasia are found to be used interchangeably with much confusion as to just what type of lesion was being described. The word atresia as derived from the Greeks means "without a boring," or, to us, an imperforation, absence or a closure of the intestinal lumen. However, it is often used to mean occlusion or any congenital obstruction, whether it be intrinsic or extrinsic. Atresia presupposes the presence, sometime in the development of the bowel, or a lumen of which there is subsequently complete (occlusion) or partial (stenosis) obliteration. In this report the word occlusion will be used to mean a complete congenital intrinsic closure of the lumen of the intestinal tract. Misuse of terminology, therefore, makes the statistics on a number of cases of this type of lesion very confusing, and on this basis some publications may have been missed in the bibliography of this paper

Duodenal obstruction in the newborn is either congenital or acquired. The acquired type is either (1) mechanical, such as seen in hernia, volvulus and Meckel's diverticulum, or (2) adynamic or neuromuscular in character or much the same in origin as Kirschsprung's disease is thought to be. The etiology of the congenital forms of obstruction is still in the theoretical stage. One theory is that it is due to the failure of the bowel to acquire a lumen during the course of development or that the lumen is obliterated by proliferation of the epithelium. Another is that the obliteration is inflammatory. Ladd and Gross tend to believe that the etiology is due to failure in opening of the lumen during embryonic life.

Until recently, all cases of duodenal occlusion were fatal, regardless of what form of treatment was instituted. Cordes, in 1909, and Spriggs, in 1912, had a very excellent review of literature up until that time and found no successful cases published. In 1913, Webb and Wangenstein published a paper in which nine cases had been operated upon successfully for some form of upper intestinal obstruction. Five of these cases were some form of occlusion of the duodenum. All the reviews through 1912 presented a completely hopeless aspect as far as treatment of this condition is concerned. As far as we can ascertain only fifteen patients with complete atresia of the duodenum have survived operation. This review is incomplete and presented at this time to show that what appeared to be a hopeless situation a few years ago is now beginning to show some degree of encouragement.

CASE REPORT

The patient, an infant, was born September 11, 1943, in St. Vincent's Hospital. Its weight at birth was seven pounds and four ounces. It was noticed that after the first feeding the infant vomited the entire amount. This continued after each feeding, regardless of whether it was breast, house formula or plain water. All vomitus was bile stained. On the third day, a pediatrician was called in and a tentative diagnosis of pyloric stenosis or obstruction of the duodenum was made. On September 15th, an *x*-ray of the stomach was made using barium as contrast media which showed a complete obstruction between the second and third part

of the duodenum with considerable ballooning out of the first part. In the discussion of this case, the differential diagnosis was between an

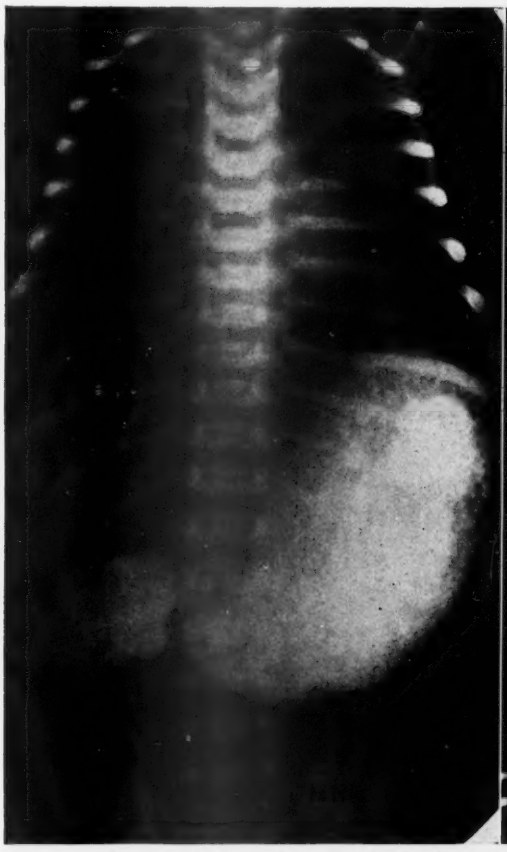

FIG. 1. *X*-ray picture of stomach, barium sulfate contrast, fifteen minutes after taking, shows normal duodenum cap, but ballooning out of first part of duodenum, with complete atresia of second portion. Note there is no gas patterns in either the small or large intestines.

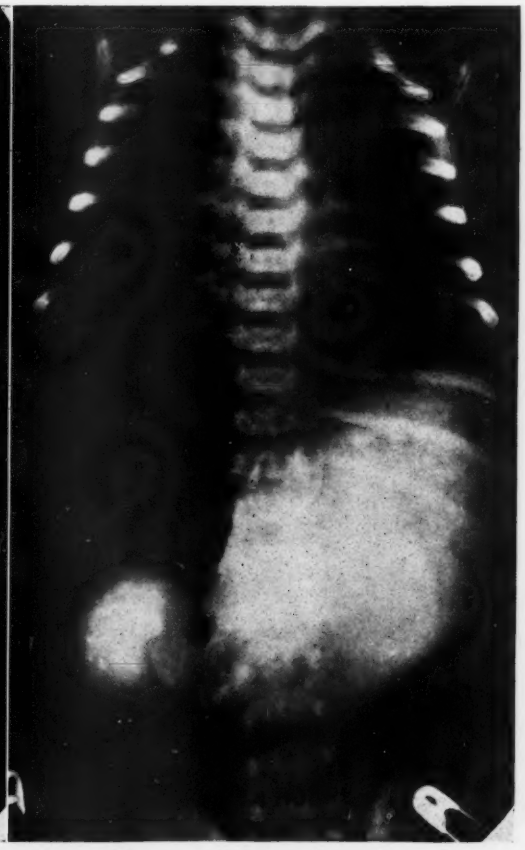

FIG. 2. Picture taken four hours later shows no entering of stomach.

obstruction of the duodenum at the ligament of Tritz by a peritoneal band, volvulus of the duodenum or pyloric stenosis, the latter probably being ruled out by the presence of bile in the vomitus.

The infant was prepared for surgery by the administration of adequate fluids and gastric lavage to decompress and clear the stomach of all barium. On September 16th, the operation was performed under light ether anesthesia. The pylorus was found to be normal. However, the first part and the proximal half of the second part of the duodenum was ballooned out, showing an obstruction somewhere in the second or third portion of the duodenum. The ligament of Tritz was normal and no obstruction found at this point. A posterior gastrojejunostomy was done using No. 0000 chromic intestinal sutures for the inner and outer tiers, the latter being reinforced with cotton "a" interrupted sutures. The incision was closed with cotton sutures. A transfusion of 50 cc. of whole citrated blood was given the same day of operation. A stomach tube which was placed in prior to operation was left in for irrigation with warm sterile water at one hour intervals. Some old blood and barium were washed out.

On the night following the operation the patient began to bleed from the incision. Two mg. of vitamin K was given at that time and repeated three times a day for two days. The hemorrhage stopped shortly after the first injection and did not re-occur. Another trasfusion was given on the third and sixth postoperative days. On the third postoperative day the stomach tube was removed, and the administration of ½ oz. sterile water every three hours was begun. This was retained fairly well by the patient and on the fifth day Similac, same amount, was substituted. This was gradually increased up to normal feedings for

the infant's age on the tenth day. On the twelfth day the patient began to gain weight and to have normal bowel movements and was

Fig. 3. Picture taken thirteen days after operation shows the ballooning out of the duodenum still present. However, there is emptying through the posterior gastrojejustomy.

dismissed on October 25th. Its weight was 8 pounds 13 ounces and appeared to be normal in all respects. Rechecks on patient at two months, four months and six months show it to continue to gain weight and take its food normally.

In the discussion of the treatment of duodenal occlusion one finds that the only treatment that has been satisfactory is either a gastrojejunostomy, duodenoduodenostomy, or duodenojejunostomy with the latter being preferred by most men. In reviewing the literature it was found that all cases which were not treated in this manner were fatal. As pointed out by Ladd and Gross and in other papers, the infant cannot tolerate tubes in the small intestine for feeding purposes as is often used in upper intestinal obstructions in adults. No patients who had tubes inserted survived. This is probably due to the delicate fluid balance that one encounters in the infant. The infant does not tolerate the loss of essential body salts as well as the adult does. When death follows such operations, there is pronounced dehydration, inanition, and gradual wasting with a terminal pulmonary infection. Not only is this true of duodenal or upper intestinal obstructions, but in all cases of obstruction to any part of the bowel. The infant will not tolerate a Micklet's type of anastomosis as the adult does, and it is found advisable in cases in which resection of the intestine is indicated that it be done in the one-stage instead of the two- or three-stage operation. It is surprising to note that the infant can survive this one-stage operation so well. A very important fact to mention is that the duodenum should never be explored. The intestine is usually edematous at this point, due to the stretching of the wall and will break down and the patient die of peritonitis.

Certain precautions should be observed in surgery in infants. These precautions have been pointed out in several publications, but are so important that they cannot be mentioned too frequently. These are: (1) *preoperative care.* It is very important that adequate fluid balance be obtained prior to operation. Most patients who require intestinal surgery are first seen in a dehydrated state due to persistent vomiting and operation while in this state is dangerous. It usually requires only a few hours to obtain adequate balance, and regardless of the seeming emergency of the operation, the time spent in preparation will bring reward. (2) *Anesthesia.* Most men doing pediatric surgery prefer light ether anesthesia, by the open drop method. Some precautions that might well be used are (1) wrapping the extremities in padded cotton to prevent

the escape of body heat which is more apt to occur in infants; (2) having the operation room warm; (3) using vitamin K intramuscularly should be routine as it helps to prevent the capillary oozing which is often very marked in these cases; (4) postoperative care. Infants should receive plasma and whole blood transfusions following any surgery on the intestinal tract. This helps build the patient up and also helps to prevent edema at the sight of anastomosis. The stomach should be repeatedly washed out and aspirated as long as there is any tendency to vomit.

SUMMARY

Up until recently, all cases of duodenal occlusion in the newborn were found to be fatal regardless of what form of treatment was instituted. However, the present form of treatment, which consists of a short-circuiting operation of the obstruction with duodenojejunostomy, is the preferred operation. It is noted that this surgery must be done early since the infant dies from dehydration and other complications of intestinal obstruction quite early.

CONCLUSIONS

1. Duodenal occlusion in the newborn is amenable only to surgery.
2. Surgery must be performed early.
3. Only short-circuiting operations should be performed.
4. Exploration of duodenal is not advised.
5. Preoperative and postoperative care is very essential.
6. With this publication only sixteen patients have survived.

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SOLITARY CYST OF THE KIDNEY*

CASE REPORT

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THE correct diagnosis of a solitary cyst of the kidney is seldom made preoperatively. Most reported cases have been found during surgical procedures for other conditions and others have been added at the autopsy table. Although diagnosed as early as 1634, Lowsley and Kirwin[4] in reviewing the literature, have collected only a little over 300 cases. In 147,657 admissions at the Beth-El Hospital, this is the second instance of a solitary cyst of the kidney, one having been reported by Dr. A. L. Greenberg[2] in 1939. Cases have been reported by Herbst and Polkey[3] and by McCrea.[5]

This tumor is usually found during early adult life and found equally in men and women. It is in most cases a large cyst, more commonly at the lower pole of the kidney. The most favored theory as to its etiology is that it is probably congenital. Others believe that it is a retention cyst occurring after tubular obstruction.

FIG. 1. Flat plate showing large cystic mass attached to the lower pole of the right kidney.

FIG. 2. Normal pyelogram; cystic mass attached to the lower pole.

Pathological study[1] shows a cyst, which is unilocular or rarely multilocular, with a clear yellowish watery fluid which contains albumin, epithelial cells, leucocytes, chlorides, urea, and occasionally blood. The cyst wall has remnants of glomeruli and is composed of dense fibrous tissue

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with areas of calcification, and lined by flattened epithelial cells.

There is no characteristic syndrome to aid in the diagnosis. Subjectively, the patient may complain of a feeling of discomfort, or experience a sharp pain as excruciating as that of renal colic. Occasionally, blood may be found in the urine. On examination, one may find a large mass in the abdomen, apparently attached to the kidney, and *x*-ray may show distortion of the pelvis, calicyes, or ureter, depending upon the size of the cyst. It is usually the negative findings such as normal pyelogram, normal urine, and normal blood chemistry, which aid in the diagnosis. The treatment is surgical when the diagnosis is established.

CASE REPORT

S. S., female, aged thirty-eight, was admitted to the Beth-El Hospital on June 24, 1943. She had been in excellent health until two months prior to admission, when she experienced a sudden sharp pain in the right upper quadrant of the abdomen, associated with a feeling of fullness and nausea. She subsequently had three similar attacks. There was no frequency of urination, no dysuria, and no pain referable to the kidney area. The history was otherwise irrelevant.

Physical examination, on admission, showed the head, heart, and lungs to be normal. Examination of the abdomen revealed a mass the size of a large grapefruit, which felt cystic and was moderately tender to palpation. There were no other positive findings abdominally. Vaginal examination was negative, and showed both ovaries and the uterus to be normal, ruling out the possibility of a large ovarian cyst.

X-ray studies in the form of a flat plate of the abdomen (Fig. 1) revealed a large cystic mass which appeared to arise from the lower pole of the right kidney. Pyelography was negative. (Fig. 2.) Urinalysis revealed the following: Specific gravity 1022; albumin, sugar, and acetone negative; microscopy showed several scattered white blood cells. Blood studies showed white blood corpuscles 8,700; polymorphonuclears 75 per cent; lymphocytes 24 per cent; red blood corpuscles 4,250,000; hemoglobin 86 per cent; urea nitrogen 14 mg. per cent; creatinine 1.5 mg. per cent.

Diagnosis of a congenital cyst of the right kidney was made and operative intervention was decided upon. Under spinal anesthesia, a right rectus incision was made and a large cyst of the lower pole of the right kidney measuring 16 cm. in diameter was revealed. The peritoneum of the posterior abdominal wall was split, the cyst was enucleated and resected from the kidney, and the raw area packed with retroperitoneal fat to control bleeding. The postoperative course was uneventful, and the patient was discharged on the tenth postoperative day in good condition.

Fig. 3. Low power magnification of cyst wall, a fragment of kidney tissue.

The pathological report by Dr. Mendel Jacobi is as follows:

Macroscopic Description: The specimen is composed of an empty collapsed thin transparent solid cyst apparently 6 cm. long, 3 cm. in diameter, its inner surface folded and glistening; a small fragment of what appears to be kidney tissue is attached at one end.

Microscopic Description (Figs. 3 and 4): The cyst wall is composed of dense acellular fibrous tissue, the cyst surface is lined only in part by a single layer of regularly arranged atrophic and flattened cuboidal epithelial cells resembling those found in the tubules. At one end of the section is a fragment of kidney tissue showing a moderate stromal fibrosis and focal lymphocytic infiltration.

The glomeruli in the fragment of renal tissue show varying degrees of fibrosis; the larger arteries similarly show mural thickening and fibrosis and lumen stenosis. At a distance from the cyst lumen, the renal tissue shows no histologic changes other than a slight interstitial lymphocytic infiltration. Diagnosis: Congenital cyst of the kidney.

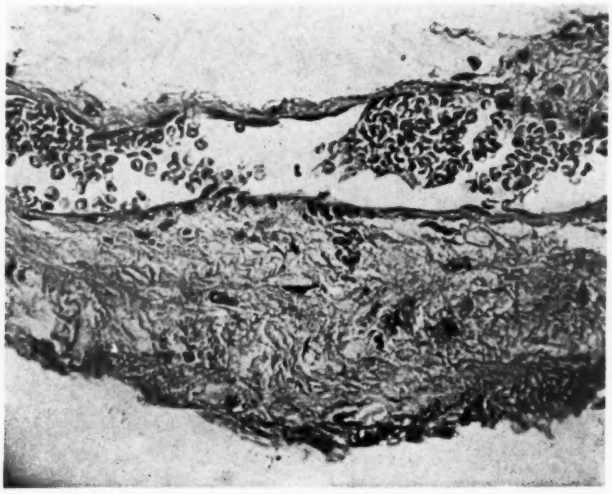

Fig. 4. High power magnification of cyst wall, atrophic cuboidal lining epithelium.

SUMMARY

A case of a solitary unilateral congenital cyst of the right kidney in a thirty-eight year old woman, diagnosed preoperatively, is reported with a brief description of the diagnosis, pathology, and treatment.

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Bookshelf Browsing

PHYSIOLOGY OF THE UNSHOD AND SHOD FOOT WITH AN EVOLUTIONARY HISTORY OF FOOTGEAR

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ALL physicians are constantly confronted by baffling functional foot troubles. The public is assailed by advertisements claiming a certain shoe feature or pedigree of endorsement has "the answer to the maiden's prayer" (used advisedly.) Yet no inquiry I know of approaches the problem analytically; no shoe that I have found fits every foot, relieves all pain, delights every eye. It would seem that the fundamental problems are to determine (1) the elemental physiology of the human foot; (2) the reason for being of the several types of foot gear; (3) the effect of each innovation on foot physiology; (4) to suggest logical solutions for the common difficulties.

In the unshod Polynesians, Melenesians and Micronesians that I have observed, there are four overlapping but distinct phases of foot activity, which differ only in degree from other individuals who are accustomed to walking unshod a part of the time.

PHYSIOLOGY OF THE UNSHOD FOOT

The contacting phase which is universally initiated as the heel strikes the ground[32] is followed by sequential contact of the fifth and first metatarsal heads. This, so far as the foot is concerned, is a passive act, as the contacts are made by the body coming over the grounding foot.

The primary prehensile phase begins just before the head of the fifth metatarsal is grounded and ends just as the head of the first metatarsal makes contact. It consists in an active dorsiflexion of the toes at the proximal joint, while the distal joints are kept extended. The toes tend to spread as they are dorsiflexed. This act permits of phalangeal adjustments to surface irregularities such as pebbles.

The postural or weight bearing phase corresponds to standing, and occurs during the brief period while all three major weight bearing points are in contact with the ground. It is during this stage that the foot lengthens and widens slightly. One may feel the postural contraction of the abductors hallucis and minimi digitii and the adductor hallucis. These contractions are in response to proprioceptive reflexes caused by the spreading of the pedal tripod. The tension in the abductors ceases abruptly as the heel leaves the ground. It should be noted that proprioceptive end organs are said to be most plentiful in the small muscles of the feet and hands.[38] Thus, the foot is essentially a tripod held in a normal relationship by reflex activity in the intrinsic muscles of the foot. It is not a bag of bones held together with ligaments. The vaunted arches are incidental to its structure and of no more essential importance than the tilt of the tip of one's nose or the color of one's iris.

The propellor phase begins as the postural phase ends. It is characterized by a passive dorsiflexion of the extended toes at the proximal joint, and an active contraction of the toe flexors and tightening of the plantar fascia. It is this potential flexion

which gives them the bite essential for propulsion. As the dorsiflexion begins all the toes are grounded; as flexion increases the toes are successively raised from the ground, beginning with the fifth. Generally, the great toe (but frequently the second toe) appears the longest. Except in extreme instances functionally the great toe is always the longest, by reason of the fact that its head is elevated on the sesemoids projecting it functionally well beyond the second metatarsal head. In club feet and metatarsus varus the first metatarsal is frequently very short, and the attempt to ground it tends to cause a persistent varus. Lifting the head of the first metatarsal on a pad tends to improve the gait.

It would appear, therefore, that for maximum pedal efficiency it is essential that (1) the weight bearing points should be permitted normal spatial and chronological contacts; (2) the toes be permitted full active and passive dorsiflexion; (3) the foot be allowed to lengthen and broaden normally.

DEVELOPMENT OF SHOES

The story of "Shoes" is a drama filled with discomfort and vanity, suffering and disease, wars and wounds, trials and errors. Of their origin we cannot speak. The earliest known shoes were used in Egypt about 3500 B.C. Their preservation tells not of beginnings but of a preserving aridity through five millenia and more. Their finished workmanship reveals master hands in long established trades.

The appearance of unique but related types of footgear either reveals the shod marches and voyages of pre-history, or the independent development of similar solutions in geographically and ethnologically unrelated areas. We may not trace the sequential history of the shoe's development in early days, but we may glimpse the effects of temperature, precipitation, terrain, and comparative cultural development.

Each people used the materials at hand —the Polynesians and Egyptians native basts, the Europeans basts, wood and leather, the Eastern Orientals wood, basts and cloth.

So far as I can determine, tropical jungle dwellers are unshod peoples. Here they have the rotting carpet of the forest glade, and soothing mud by cooling streams. Keith[22] found any type of shoes unnecessary and uncomfortable save for tender feet, and considered the dangers of the forest folk the lesser of two evils.

Desert dwellers everywhere seem to have found untempered heat a trying problem for their feet. Their answers differed with other factors, as rainfall. The Egyptian's problem was simplest and he developed a simple answer. While sandals are found as far back as the middle of the fourth millenium B.C., it was not till the age of the builders of the pyramids (Dynasty V, 2750–2625 B.C.) that sandals began to be used semi-routinely by the ruling classes bespeaking a relationship between hot stones and tender feet.

The sole of the Egyptian sandals generally consisted of wood, leather or fibers; some of the latter are like beautifully wrought pieces of basketry. These were retained by a T-strap (Fig. 1) whose stem passed through the sole between the great and second toes, and the arms were attached to the sole beneath the malleoli. An interesting and unusual variation is found in the sandals of Wah (2000 B.C.) (Fig. 2) now in the New York Metropolitan Museum. These consist of a flat wooden sole about a quarter-inch thick. A properly placed (2 to 2½ inch) quarter-inch dowel toe pin was thrust through the sole at an angle of 45 degrees. Similar pins about one inch long were set beneath each malleolus. Through the tips of these pins and completely surrounding the foot was a half-inch band of thin pliable material.

Egypt is an arid land where rain is held a curse. Only the flick of a toe lay between the slap of Pharaoh's sandals in Karnak's sunburnt courts and the padding of his naked feet in that holy temple's shadowed

halls. In semi-arid Mesopotamia, on the contrary, there is five to ten times the rainfall of Egypt, and the lightly held sandals of Egypt would be lost in the occasional mud of Assyria. This altered both problem and answer. Instead of the T-thong, the forepart of the sandal was fastened on by a loop through which the great toe was slipped. (Fig. 3.) This thong, if one may judge from bas-reliefs, crossed on the dorsum of the foot and was then caught through loops on either edge of a leather quarter, an innovation which held the heel in place, preventing both the familiar sandal slap and the easy discarding of sandal at the portal.

Fig. 1. Sandal of Tutankhamen (1350 B.C.). Reconstruction of most elaborate of sandals found in his tomb. Most Egyptian sandals omitted the uppers and quarters. Drawings made from photographs in Carter's "Tomb of Tutankhamen." It appears to have been made of basts, cloth, metals, and either enamels or jeweled inlays.

The Polynesians on their coral-wreathed volcanic islets were confronted with two problems: (1) the knife-like coral of their fishing ground, and (2) the aa (Polynesian and geological term for rough or jagged) lava of their island homes. The problems of the reef furnished a variant of the Babylonian solution. Their sandals had to be retained not against the pull of inert mud, but of rushing water. It was necessary that the heel be fastened on, but a solid Babylonian counter would form a cup, giving the water an additional purchase on the sandal. The Polynesian caught a heel strap through loops beneath the malleoli and tied the thong around the ankle. This gave no obstruction to the movements of the sea. However, the free lateral border of the ancient form of sandal would be subject to some dragging force. To meet this a second interdigital thong was introduced between the fourth and fifth toes. The Cook Islanders[6] and Maoris[5] put the fixed loop behind the heel and the long tying thongs came between the toes. The Hawaiians used the fixed loop between their toes with the tying thongs at the heel. (Fig. 4.) The Maoris caught the lacing thongs through several lateral loops in the manner of the Greek and Roman.

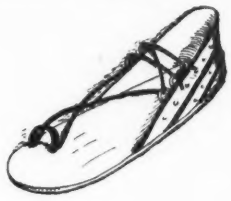
It should be observed that the Mayans used the same principle of a double toe thong, but living inland they used a solid counter. (Fig. 5.) They, however, ran the lateral thong between the third and fourth toes. I do not know the ethnological significance of these facts.

Both coral and aa lava caused rapid wearing of the bast soles of the Polynesians. Buck[6] quotes Skinner[41] to the

effect that on some expeditions each individual carried from five to twenty pairs of sandals.

All of these solutions were aimed at one thing—plantar protection—protection against heat, geological formations and

Fig. 2.



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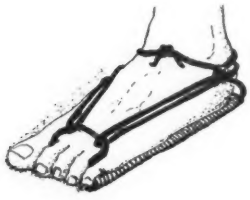

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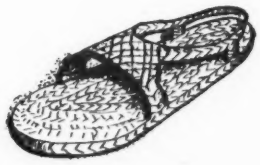

Fig 7.

Fig. 2. Sandals of Wah—2000 B.C. Metropolitan Museum, New York. Wooden sole and pegs; leather strap; not commonly found.

Fig. 3. Sandals of Assyria, 750 B.C. Probably all leather. Note toe ring and solid quarter. Reconstructed from statutes and descriptions. The quarters were alternately striped, frequently black and red.

Fig. 4. Bast sandals of Hawaii. Bishop Museum, Honolulu.

Fig. 5. Sandals of Mayas, from statue in American Museum of Natural History. The feet were very square. Note similarity between this and Figure 4; probably leather.

Fig. 6. Japanese Zori of bast and cloth.

Fig. 7. Inca sandal reconstructed from foot of drinking cup shown by Mead—Inca Land.

The Japanese arrived at a different solution. They made use of the bast mats, but instead of the T-strap of the Egyptians they adopted a V-strap which spread from between the toes to either side of the sandal. These are called zori. (Fig. 6.)

The Incas,[30] judging from the foot of a cup that has been preserved, found the value of a waist strap across the foot rather than an interdigital thong as a retaining mechanism. This avoided the chafing effect of the thongs on moving parts. (Fig. 7.)

plant products. A related problem is concerned with blunting the effects of cold on the delicate dorsum of the foot and leg. So far as I know, this always happened beyond 40 degrees latitude and in high cold countries farther south, as Central Asia. As in the case of heat, so in the problems of cold the sufferer used the materials at hand. In parts where hair or fur-bearing animals existed, the simplest solution was to wrap the foot and leg in a piece of hide and bind it with a thong of fiber or leather. This was probably the

earliest solution of the problem of foot protection, and is the method still reverted to in dire want.

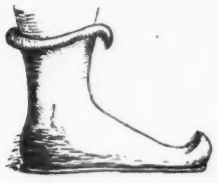

Fig. 8

Fig. 9

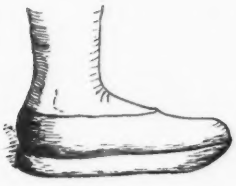

Fig. 10

Fig. 11

Fig. 12

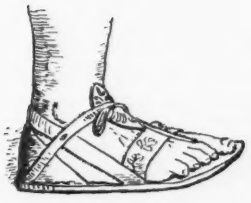

Fig. 13

Fig. 8. Shoe from sandals of Assyrian captives portrayed in several works; about 750 B.C.

Fig. 9. Felt (?) boot of Mongol Prince dated 1262 A.D. Shown by Martin. Note attempt to represent arch of foot.

Fig. 10. Chinese thick wooden soled shoe; contemporary for use in wet weather.

Fig. 11. European sabot.

Fig. 12. Japanese wooden geta for wet weather with tabi for warmth; contemporary.

Fig. 13. Greek sandal showing beginning of armoured tongue for foot protection. Shown by Gulick.

In mammalless New Zealand the Maori used indigenous basts to cover his feet, but I fear such material must have yielded a harsh, cold comfort.

The second phase in the development of the upper was the fashioning of the skin to the owner's foot and leg. This required the cutting and sewing of darts, the trimming away of excess leather, and the formation of loops for lacing, or the swaging of the wet leather to a mold. Such shoes or boots are represented on early Babylonian carvings of people from the north. Sometimes the shoes were moccasin-like, sometimes almost boot-like. (Fig. 8.)

Fashions changed as man developed new materials. Felts made before history begins were used early to form the footgear of the peoples of Central Asia and Europe. (Fig. 9.)

Weaving, too, antedates history, and the products of the loom were used betimes to form foot coverings. In some instances the cloth was used as skins had been before; the Chinese fastened cloth uppers to wooden soles at least 600 B.C.[40] (Fig. 10.) The cloth top was used in summer, leather tops in winter.[26] Another solution to the problem developed independently

in Western Europe and Japan. For indoor wear the cloth sock or hose sufficed, but in outdoor use the cloth quickly wore through. In Europe this lead to the development of the galoshe, or pattern, a wooden sole with a cross strap for the ball and a quarter caught over the instep. These were slipped on and fastened over the cloth sock. The Japanese retained the thonged bast (zori) or wooden sandal (getá) and wore in addition a great-toe-stalled ankle height cloth shoe (tabi). The heavy sole could be put on or off by a mere flick of the toe. The degree of cold could be countered by altering the weight or character of the tabi.

The third basic problem concerned personal and possibly household cleanliness and dampness. The Chinese found the simplest but most weighty answer when they increased the thickness of their wooden soles, forming them into inverted and truncated pyramids which could be freed from the mud seal by a slight tug. A similar but less weighty solution was found in the European peasant's sabots, clogs and patterns, in which the sole was hollowed out under the instep. (Fig. 11.) The Japanese still further lightened the shoes for this purpose by reducing the piers to minimal size and weight, or by the use of cork soles. (Fig. 12.)

In Roman times elevated paths were built by the sides of the roads and properly placed stones permitted crossing from side to side without interfering with the movements of chariots and other vehicles. However, this refinement seems to have been neglected during the Dark and Middle Ages, and the term sidewalk does not appear in English until 1667, and in America until 1739;[36] since which time it has been a potent factor in the life of human feet. The building of sidewalks has formed a great social movement for dry feet and clean homes.

The final attack on the problem of moisture and mud was delivered from a new angle, the clothing of the feet with a light impenetrable pliable membrane. The solution was conceived and perfected by Goodyear in 1839 when he developed the technic of vulcanizing rubber.[11,12]

Modifying protective requirements entered into the development of shoes. The darkness of Egypt presumably led to the same results as the modern blackout—broken toes. The toes of Egyptian sandals were frequently turned up as toe-guards. Upturned toes still characterize Levantine shoes.

The Greeks and Romans, judging by their protective measures (Fig. 13), seemed to be more in the habit of dropping things on their feet and hurting their shins, for the shoes of the fighting man of Rome frequently had incorporated into them a metallic toe-cap, or a tongue-like metallic guard on the dorsum of the foot that was frequently highly decorated. These shoes were spoken of as caliga. From them an ostentatious emperor received his nickname, "Caligula." The boxed toe of modern shoes and the steel capped industrial shoe would seem to stem from this ancient root.

Frequently the Polynesians[4] cut their feet on sharp coral, and these cuts are notoriously difficult to heal. Either the exigencies of life or their carefree zest for living led them to try to protect their injured feet so they could carry on. Their device was very ingeneous in that it prevented motions of the injured sole. They took a thick slab from the side of a coconut husk, passed a bast thong through a slot on the convex side, and tied it around the foot which rested on the flat surface. The injured man could now rock along without moving the injured part.

Vanity and disease, especially deformity, are frequently inseparable twins, Ovid remarking at the opening of this era, "Nor should an ill shaped foot be ever bare." We do not know why the Etruscan maid that modelled for the little statuette (600 B.C.), now in the Metropolitan Museum in New York, wore long pointed toes on her shoes, but tradition tells us that Count Fulk of Anjou (1100) tried to

hide his deformed feet in long pointed toed shoes. This camouflage (Fig. 14) was seized upon by his court, and one's rank determined the length of his toes. Robert Cornard, a wag in the court of William Rufus, a contemporary of Fulk, pulled the toes of the French court, figuratively speaking, by converting the long toes into whales tails and curled rams horns. The length of toes fluctuated, finally necessitating the courtiers of Anne of Bohemia (1550) tying their toes to their knees. In England the whole problem of toes became so pointed that Edward IV (1442–1483) in his sumptuary laws cut all toes to a short two inches. The extremes have never come again; their pain-producing powers abide.

The raising of one's heels either on wedgies or heels is a subject that is rather confused. Kelly and Schwabe[23] state that "Heels in the modern sense were practically unknown before 1600." Lester and Oerke[28] make a statement to the effect that the Cretans were the earliest users of heels. Both the statements, I believe, are in error, and I believe the history of heels is of more than ordinary interest. Evans[13] in his monumental work on the Palace of Minos at Knossos shows some primitive paintings of the human figure with the feet shaped as though they were fitted with heels. I believe the figures were unshod, for he elsewhere portrays shod feet. Breasted and Allen[3] in the folios of "Ancient Egyptian Paintings" show in Plate VII a fig picker dating from 1920–1900 B.C. with feet shaped the same way. (Fig. 15A.) The

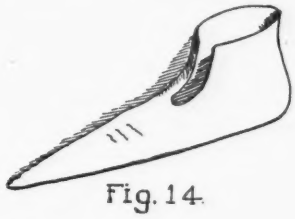

Fig. 14.

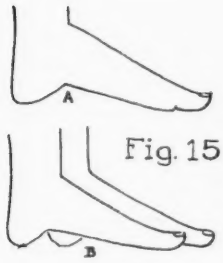

Fig. 15

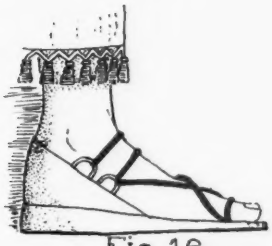

Fig. 16.

Fig 17.

Fig. 18.

Fig. 14. Long pointed toes; used from 1100–1500 A.D.

Fig. 15 A and B, feet from Plates VII and XXXV of breasted, showing representation of arch in barefooted individuals. Much like Figure 9. Note absence of small toes on near foot of B.

Fig. 16. Wedgie worn by Assur-nazir-apal about 850 B.C. Taken from bas-relief in Metropolitan Museum, New York.

Fig. 17. The heel of Timur, from a miniature dated 1467. Shown by Martin. The first true known heel in history.

Fig. 18. Shoe of the time of Henry VIII.

figure is barefooted. Plate XXII shows "Two Cretan Tribute Bearers" in the time of Tuthmosis (1475–1448 B.C.) with a similar rendering; they, too, are unshod. Plate XXXV (Fig. 15B) depicts two seated figures partaking of the daily meal within the tomb. Their feet are placed one slightly in advance of the other, and the heel of the more distant foot shows through beneath the arch of the nearer foot. In short, the technic which Lester and Oerke thought was a heel is an attempt by the painters of that day to recognize the human arch, but their skill was not equal to the task. The shape of the foot reminds one of the Tartar's Boot dated 1262 A.D.[29] (Fig. 9.) I have seen the same technic used by the Egyptians to try to represent one person beyond another.

A bas-relief of Assur-nasir-apal III (885–860 B.C.) (Fig. 16) in the Metropolitan Museum in New York represents this warrior king as shod with wedgies. Layard[25] shows a bas-relief with this king wearing wedgies while his attendants are flat soled. Assurbani-pal (668–626 B.C.) likewise is represented as wearing wedgies.[24] Intervening monarchs are represented as wearing flat soles. These two wedgie wearers were the greatest warrior kings of Assyria. No trace of a true heel is found for twenty centuries till we come to the days of Timur. All pictures of mid-Asians from the eighth century onward show heelless boots and shoes. Timur, prior to the battle of Seistan, was simply known as Timur, but after that battle he had to retire to recover from wounds of his foot and hand. Thereafter he was Timur the lame or Tamerlane.[24] A miniature of him in 1467[29] shows him as wearing what is obviously a heeled boot. (Fig. 17.) In western Europe, as Kelly and Schwabe[23] state, "Heels in the modern sense were practically unknown before 1600."

Judging by others whose injured feet have received primitive care, it is not unreasonable to suppose that Timur developed a contracted heel cord. The putting of a heel under one foot would reduce the pain of stretching, but would not affect the limp. The use of a heel under each foot would reduce the limp. The uniqueness of the heels would be hidden in a heeled court. This courtly method of covering royal defects is not unusual. Hanoverian George I could not pronounce Th except as T, and hence the old English Thāmes became Hanoverian Tems; neither could he change a Germanic ei (i) to the English ei (e) and hence English nēither became Germanic neīther and ēither became eīther.

A century after Timur true heels began to appear in Western Europe. At first they were detachable objects of personal adornment. Later they became integral parts of the shoe but retained their decorative possibilities. Broad and low in the beginning, under Spanish and French influence they attained extreme heights, and the wearers teetered down the street spraining and breaking their ankles. The more stable and supportive "wedgies" returned for a time in the days of Elizabeth, only to reappear in our own day.[7,9,14,19,23,27,28,33,39] It seems to me probable that the heel is essentially a prosthesis for shortened heel cords, and that men and especially women are still paying unconscious tribute to the vanity of a wounded Tamerlane, or Assur-nazir-apal.

These two raisings of the heel proper must be distinguished from the general elevations of the foot as we have seen in various mud shoes. In Europe this general heightening of the body stems from the cothurnus of the tragedians of Greece and Rome. Tertullian[42] speaks of this piece of footgear as the "lofty buskin, impiously striving to add a cubit" (18 inches). Obviously he could not be referring to a single posterior heel. This is borne out by the surviving statues of tragedians who trod the stage on cork blocks like children walk our streets on empty cans. From their use comes also our expression "high tragedy" as compared with "low comedy." Disappearing from the European scene for a long period these stiltlets reappeared by way of Baghdad during the Renaissance

as the Italian and French chopine—miniature coffee tables or ash stands—that raised the owner toward the Tertullian cubit which required two attendants for every wearer. These obviously issued from the vanity of a fingerling.

Henry VIII, the gluttonous playboy of English history, suffered from gout as well as a plethora of women. The long, low stuffed toes of Fulk would rest painful on Henry's knobby feet. This seems to have been the age of gout, for shoes had great square baggy toes. (Fig. 18.) The French, who had started the medieval rage for long toes, now sponsored the extremely broad square toes, and Lester[27] states that "one was not considered fashionable in France whose shoes did not measure a foot across the toes." Even England must have gone to an extreme, for Henry limited the width of toes to six inches. The square toed shoes of Henry were modified under the Stuarts and Cromwell, but the toes of Fulk and of Henry have remained in essence to this day, with a gradual resurgence of form-fit shoes.

Practically all shoes and sandals of Europe and Western Asia, except the long toed shoes of the Etruscans and those fashioned after Count Fulk and Henry the VIII, were shaped to rights and lefts. After them came a period when shoes apparently were unpaired. Not till the end of the nineteenth century did men again form shoes to individual feet.

The last major contribution was the installing of a metal shank to (1) preserve the shape of the shoe, (2) maintain the heel in position, (3) give the foot the support which had been removed by (a) the introduction of the heel, (b) the extension of sidewalks, (c) the more general and continuous use of the shoes. This, so far as I can determine, is a recent innovation dictated by necessity and not by royal whimsey, for the use of the word in this sense does not appear before 1875.[36]

The eternal primary requirement of footgear is for plantar protection; intrinsically of nearly equal importance is the method of retaining the protective sole and giving warmth to the foot and leg, and that tertiary significance may apparently be assigned to other factors, as the shape, heel and shank; that the decorative factors are inconsequential except to the peace of mind of individuals who fit their clothing to their heads rather than bodies. However, from the standpoint of physiology the arrangement in importance of the elements may be very different.

PHYSIOLOGY OF THE SHOD FOOT

The third part of our problem is concerned with the physiological effects of the several parts of our footgear on the foot.

In studying soles we shall consider heelless sandals hypothecating an adequate method of retention which will in no way interfere with foot physiology. From this standpoint a *fully flexible sole* would seem to be ideal, provided it afforded adequate plantar protection. In reality it is used either out-of-doors to provide additional protection to already hardened feet, as by the Indian, or indoors as a slight protection to tender feet, as in the house-slipper. The Indian would not deign to wear them on our polished floors, while tender feet with them would be wrecked on the rocky mesas of Arizona.

The *semi-flexible sole* affords much greater protection to the wearer and only prevents plantar flexion of the toes. This adaptive or primary prehensile phase of toe activity would no longer be so essential. This is the common sole of men's shoes.

The *inflexible sole* may be either (1) flat (Fig. 2), as in the sandals of Wah, or (2) moulded, as in the ordinary pattern. Either would prevent not only the primary but also the secondary prehensile phases of toe activity, and would permit normal physiology only in the static stage. The flat inflexible sole would throw all flexion and extension into the ankle joint, causing a very awkward gait. The moulded inflexible sole would tend to overcome this difficulty, but its roll is hard to control, as one sees in pattern wearers.

The interdigital thongs of Egypt, Polynesia, or Japan would cause no interference with any form of foot physiology. The quarter, either closed as in Babylonia or open as in Polynesia, would have little if any effect on normal foot physiology. The upper which binds the foot to the sole, has a much greater influence. Let us presume a flat rigid sole such as the sandals of Wah. As it was constructed originally, as Wah passed from the static stage the heel loop of pliable material permitted the heel to rise a variable distance, giving him at least a modicum of the normal passive dorsiflexion of the toes. On the other hand, if this shoe had been constructed with a complete upper, as in the case of clogs, the wearer would have to lift his foot directly from the ground at every step; there would be no rolling from one phase of the step to another. The use of a semiflexible sole, however, would permit the normal fourth or push-off stage, even with a complete upper, provided it approximates the shape of the foot, i.e., with a straight inner edge and an oblique lateral side and an anterior border paralleling the toes. The making of shoes to the shape of the wearer's foot was largely a function of the ancient shoemaker as distinguished from the cobbler (Tables from Tolstoi) or butcher. The introduction of machinery standardized lengths, widths, shapes, etc. The fallacy of this method is reflected in a great measure by foot discomfort, but may be seen in any open heeled shoe in which a certain number of people are seen whose heel projects usually far to the inner side beyond the top of the heel, indicating a varus element in a certain proportion of normal feet.

Other factors, such as chafing, might be the critical one. Whether the shoes were high or low might depend on their proposed use or the climate. However, the upper, regardless of the type of sole, must be large enough or elastic enough to permit the slight static spread of the third or postural stage of foot physiology. From the standpoint of adequate easy retention and maximal physiological activity of the foot, the ideal was probably attained either in the sandal of the Incas, in which retention occurred in non-moving parts (Fig. 7), or by the Japanese use of the stalled tabi with the zori. (Fig. 6.) I have never known or found any doctor who has ever had a zori wearer complaining of foot difficulty.

The method of fastening the upper is of passing interest. Thongs antedate history. Buttons were used on shoes in Cyprus in the sixth and seventh centuries B.C. (Metropolitan Museum, New York.) Buckles or fibulae date at least from Roman times. Hooks and eyes are used on tabis, but I do not know their age. Elastic inserts are less than a century old, and zippers less than a decade. These have no intrinsic effect on foot physiology.

One should remember that the heel is essentially a prosthesis for a deformity. Too many writers assume that heels—any heels—are an essential part of a shoe; few if any ever approach the heel analytically from the standpoint of physiology. What is the effect of the heel on normal foot physiology?

1. The muscles of the non-weight bearing foot appear to be toneless. The instant weight is borne on the foot, one may feel reflex or postural tone develop in the abductors hallucis and minimi digiti, and in the adductor hallucis and to a lesser degree in the other plantar muscles. The insertion of a heel even as low as that of the average man's shoe causes a decrease in the tone of these postural muscles by about a half, and there develops a slight increase in the tension on the plantar fascia. The use of a two or three inch heel completely relieves the intrinsic postural muscles of the foot of their tone, and markedly increases tension in the plantar fascia; i.e., the postural reflex mechanism of the foot is negated by heels, and passive tension on non-contractile fascia is substituted for muscle tone. When one considers the fact that many individuals never go unshod, and that even their

bedroom slippers are heeled, one can then appreciate the fact that the postural use of the muscles of the foot are rarely if ever used, and they are constantly straining on tissue with an essentially different physiology. It is not surprising, then, that foot complaints are infinitely more common among women.

2. The introduction of a heel shortens the leverage of the foot for propulsion. A woman's foot that measures 6 inches from heel to ball on the level becomes 5 inches long in a 2¾ inch heel and 4 inches long in a 3½ inch heel. This decrease in leverage would tend to increase the muscular effort required in the push-off, or it would reduce the effectiveness of the gait.

3. The introduction of any heel decreases the postural power of the erectors of the tibia. The proprioceptive reflexes on which muscle tone or postural activity depends is stimulated by stretching. The elevation of the heel either relaxes the tendo Achilles or it causes the wearer to walk with knees that droop forward in proportion to the height of the heel. If persisted in, a structural shortening of the tendo Achilles occurs that makes a return to lower heels distinctly painful. The drooping of the knee causes a relaxation of the hamstrings which are the postural stabilizers of the knee and pelvis, and so the whole postural mechanism is upset.

4. The toes are kept in more or less complete dorsiflexion, i.e., in the propellor position, and get little if any opportunity to change their positions. In the extremely high heels the tendency is for the lumbricales to be thrown out almost completely, and the longer flexors draw the toes into the position of hammer toes by tendon action. Furthermore, their retention in this position almost without change tends to the formation of capsular shortenings and other structural changes that cause pain when put under tension.

5. The higher the heel the more the toes are dorsiflexed, the more weight is thrown on the articular surfaces of the metatarsal heads, especially of the slender middle metatarsals which are essentially non-weight-bearing structures.

6. The toes as they are dorsiflexed tend to spread apart, so that the higher the heel the broader the toes should be, but in practice the higher the heel the more pointed is the toe. Thus the strain is doubled.

Thus it appears that heels from the physiological standpoint are of primary rather than tertiary importance, being the most destructive factor in foot physiology.

What then are the suggestions offered for the problem of foot protection?

1. Plantar protection may be offered in the form of semi-flexible soles for harsher wear, and fully flexible soles for lighter wear, but best of all for all ages would be the use of the unshod foot except where the going was rough, dangerous or painful.

2. If plantar protection is needed, it should be retained by a structure that interferes the least with foot activity and physiology, and yielding such protection against the weather or other dangers, as falling cargo or steel plate, as would be necessary to the protection of the foot; i.e., toe caps should be solid enough to prevent crushing, but high enough to permit unrestricted toe activity. The use of a fully flexible protection against the weather and a separate article of clothing for plantar protection, as the Japanese do, would seem to be rather the ideal, although I am not committed to the wearing of the zori, but would incline rather to the footgear of the Incas. (Fig. 7.)

3. Heels should be omitted altogether as utterly destructive of normal foot physiology, and the sole of the shoe should be moulded to the foot for adequate and normal support that is not yielded by a flat formless sole.

4. The sandals of Tutankhamen (Fig. 1) should delight the heart of any woman or the man she baits. Others have been and could be built of equal or greater beauty.

5. The shoes should be built to the individual foot. This should not be so difficult a task with plastics as with present leather and cloth shoes.

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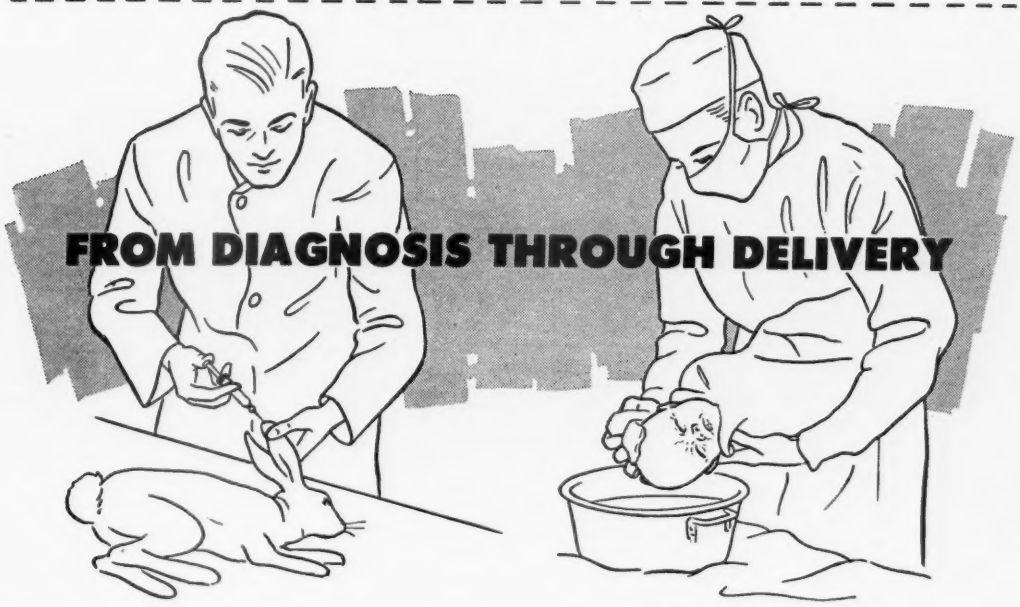

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(c) The presence of urea helps stimulate formation of granulation tissue and promotes healing.

In ¾ oz. tubes and 1 lb. jars at better pharmacies.

THE DRUG PRODUCTS CO. INC.
19 West 44th Street • New York 18, N. Y.

IODINE . . . A PREFERRED ANTISEPTIC

Its Action is Sustained

Some antiseptics are inactivated by skin and other body tissues. Iodine solutions however, have a bactericidal action which is effective for several hours. This is valuable especially when a sustained barrier against commonly encountered pathogenic organisms is necessary. The sustained action of Iodine adds to its usefulness in surgery, wounds, abrasions, chronic skin ulcers, in the relentless warfare against infection.

★ **IODINE** *Foe of Infection* ★

Iodine Educational Bureau, Inc. 120 Broadway, New York 5, N. Y.

Announcing! SEALSKIN

for use in SKIN TRACTION of AMPUTATIONS and FRACTURES

SEALSKIN

A flexible liquid plastic SKIN ADHESIVE

Patent Applied For

SEALSKIN is a flexible, hyper-allergenic liquid skin adhesive and coating. It is used for direct attachment of stockinette to the skin for traction in amputation and fracture cases where it gives a stronger bond than other adhesives used, and is more readily tolerated by the patient because the film is flexible. It is also used for direct attachment of dressings to the skin; as a protective coating to prevent excoriation of the tissue from draining fistulae, colostomies and the like. A coating of Sealskin to the skin, prior to application of adhesive prevents allergic reactions from the adhesive and also gives a better bond.

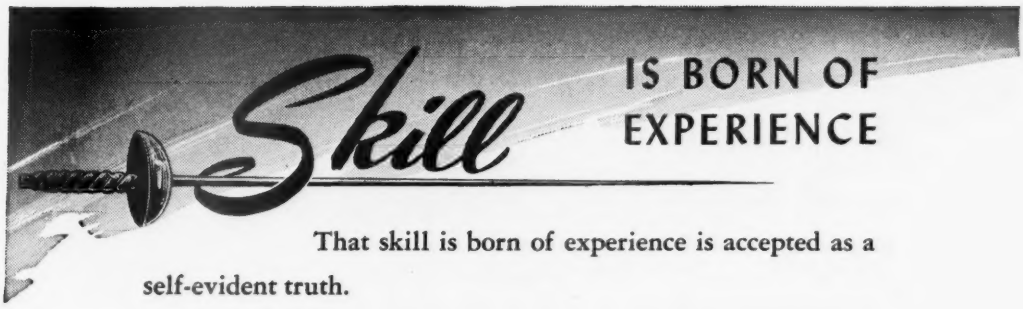
J-500 SEALSKIN, per 4 oz. jar.....$1.25

★

Order from your SURGICAL DEALER

CLAY-ADAMS CO INC.

44 EAST 23rd STREET, NEW YORK, N. Y.



IS BORN OF EXPERIENCE

That skill is born of experience is accepted as a self-evident truth.

Over a quarter century of experience in manufacturing endocrine products has made the name Harrower synonymous with dependability.

When the diagnosis establishes the need for endocrine therapy, the optimum effect may be obtained by specifying "Harrower".

The HARROWER LABORATORY, *Inc.*

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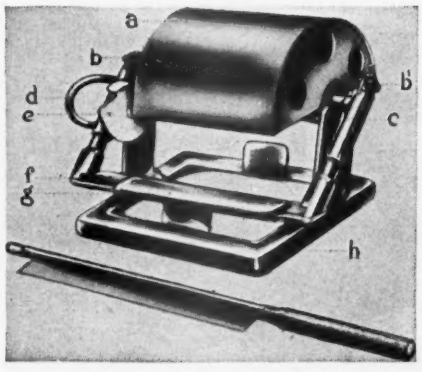
NEW YORK 7 CHICAGO 1 DALLAS 1

THE HARROWER LABORATORY At Your Service GLENDALE CALIFORNIA

PADGETT-HOOD DERMATOME



By means of this unique instrument a sheet of skin of uniform thickness may be cut at any predetermined level the size of the drum (4 x 8 inches) from any area of the body. Those who have used the dermatome state that it simplifies the technique and enlarges considerably the whole field of skin grafting. Same blade used for drum may be placed in handle and used to cut razor grafts or for honing blade. Rubber cement for the drum and donor area also is available, as well as a knife sharpening service.

Manufactured and sold by

The Kansas City Assemblage Company

609 EAST 17th ST., KANSAS CITY 8, MO.

Though the Diet May Still Be Restricted

In the postsurgical period, when speed of recovery depends so much on nutrition, need for B vitamins is increased at the very time when the diet perforce must be limited and when digestion so frequently is impaired. When supplementation with B vitamins is made routine as soon as semi-solid foods are tolerated by the patient, a quicker return to normal strength may be expected.

NOVIPLEX provides the essential components of the B complex in approximately the proportions in which they are required by the human organism. Since it is largely derived from high potency yeast concentrate, NOVIPLEX supplies *all* of the natural B complex factors, including choline, inositol, and biotin.

NOVIPLEX

Each capsule of Noviplex contains:

Thiamine hydrochloride (B_1) (1 mg.).....333 U.S.P. Units
Riboflavin (B_2, G).....1 mg.
Nicotinamide (niacinamide).....8 mg.
Pyridoxine hydrochloride (B_6)....0.5 mg.
Calcium pantothenate.....1 mg.

Plus all other factors naturally occurring in yeast concentrate. Noviplex is supplied in bottles of 100, 500 and 1000 capsules.

THE S. E. MASSENGILL COMPANY
Bristol, Tenn.-Va.

NEW YORK • SAN FRANCISCO • KANSAS CITY SEMCO

DEKNATEL SURGICAL NYLON

BRAIDED AND TREATED

Not affected by Digestive or Tissue Enzymes

Neutral, non-absorbable suture—unusually smooth—uniform in gauge and tensile strength. Action in tissues similar to silk. Stable fibres. Unusual working tensile strength.

Moisture proof	Splinterless
Serum proof	Does not swell
Wholly synthetic	Very pliable
Chemically inert	Re-sterilizable

DEKNATEL QUEENS VILLAGE 8, (L. I.) NEW YORK

Vanco Sanitary Sheet Apparatus

A Clean Sheet for Every Patient

A NEW CLEAN, WHITE PAPER SHEET IS PULLED DOWN ON THE EXAMINING TABLE.

BY A SIMPLE TEAR, THE SHEET IS REMOVED FROM THE TABLE.

COVERED AGAIN WITH A NEW SHEET, THE TABLE IS READY FOR THE NEXT PATIENT.

Adjustable and easily attached to either wood or metal table, this *Vanco* fixture holds approximately 300 sheets of soft, snow-white paper of special pliable texture.

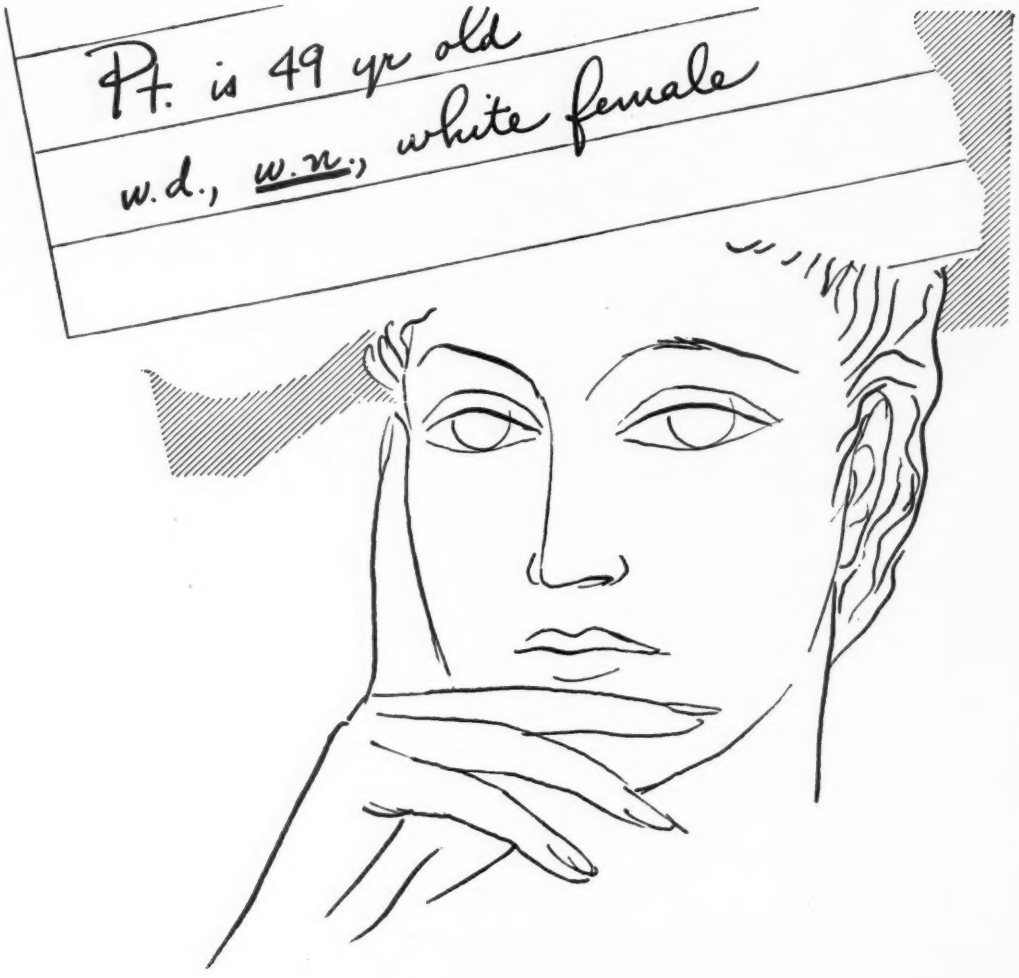
Fastidious patients will welcome this innovation. Neat. Sanitary. Comfortable. An ingenious device prevents slipping of sheet, and affords complete protection for your patients.

No more laundry bills. No more expense for new linen. Vanco complete $10.50 each. Extra rolls (approximately 300 applications) $3.00 each.

Patented

Write us for descriptive circular of our new Blood Transfusion Apparatus. Order through your dealer.

FRED HASLAM & CO., INC. **83 Pulaski St., Brooklyn, N. Y.**



But IS *she well nourished?* Too glibly written, too frequently taken for granted, good nutritive status cannot be safely assumed without careful evaluation. Even patients under active medical care—the hypertensive, the peptic ulcer, the frankly obese—may suffer from nutritive failure of "therapeutic" origin, resulting from special diets.

Spies[1] has stated that "severe atypical deficiency disease, like other forms of nutritive failure, can be successfully corrected by the application of... four essentials"—one of which is administration of the four critical water soluble vitamins in high dosage. Squibb Basic Formula is *the same formula* used by Spies[1,2] and Jolliffe and Smith[3]. It is a pioneer preparation, founded on years of clinical experience.

Each Squibb Basic Formula Vitamin Tablet contains: thiamine hydrochloride 10 mg., niacinamide 50 mg., riboflavin 5 mg., ascorbic acid 75 mg.

For complete information, write on your prescription blank "Nutritive Therapy", and mail to Squibb Professional Service Dept., 745 Fifth Ave., New York 22

Basic Formula SQUIBB

1. Spies, Tom D.; Cogswell, Robert C., and Viller, Carl: J.A.M.A. (Nov. 18) 1944. Spies, Tom D.: M. Clin. North America **27**:273, 1943. 2. Spies, Tom D.: J.A.M.A. **122**:911 (July 31) 1943. 3. Jolliffe, Norman, and Smith, James J.: Med. Clin. N. Am. **27**:567 (March) 1943.

TO STIMULATE HEALING

Topical application of White's Vitamin A & D Ointment is a clinically accepted procedure of proven therapeutic value. Indicated to promote healthy granulation and epithelization in burns of any degree or location, crushing and avulsive soft tissue injuries, all types of indolent ulcers and slow-healing wounds.

White's

VITAMIN A AND D OINTMENT

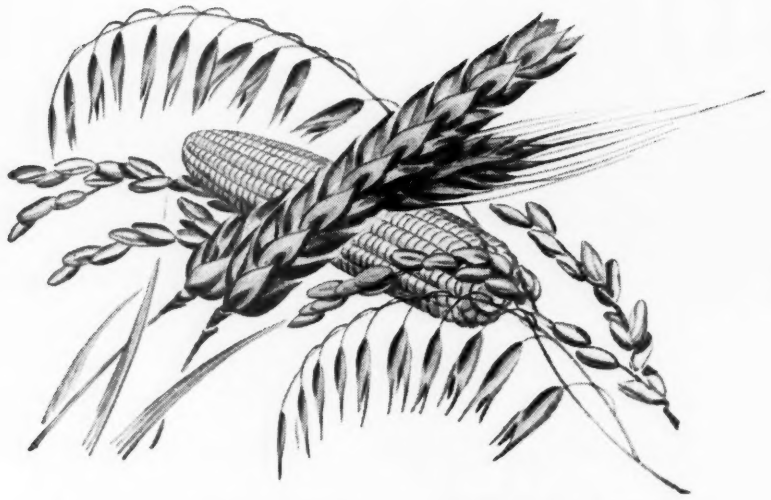
presents natural vitamins A and D in the same ratio found in cod liver oil, in a soothing, lanolin-petrolatum base. It is free from unpleasant odor, excessive oiliness and will not stain or become rancid.

Ethically promoted — not advertised to the laity. White Laboratories, Inc., Pharmaceutical Manufacturers, Newark 7, N.J.

Available in four convenient sizes: 1.5 oz. tubes, 8 oz. and 16 oz. jars, 5 lb. containers.

℞

White's PRESCRIPTION vitamins



A Wealth of Essential Nutrients in a Thoroughly Bland Food

In early postsurgical feeding cereals, whether of the ready-to-eat or to-be-cooked variety, present four distinct advantages which justify their being the first solid food allowed.

(1) The dish composed of cereal (whole-grain, enriched, or restored to whole-grain values of thiamine, niacin, and iron), milk, and sugar, presents a nutritional composition bettered by few foods. It provides biologically adequate protein, carbohydrate, easily emulsified fat, B vitamins, and minerals, the nutrients especially important after surgery.

(2) It is dependably bland, does not evoke an undesirable amount of acid gastric juice, and is digested with ease.

(3) Except in case of cereals purposely made different through bran content, it is digested almost quantitatively. There is little inert residue which might prove burdensome to the patient's intestinal tract.

(4) Cereals are available in such wide variety of taste and form that one or the other—if not all of them—is readily accepted by the patient, even if given several times daily.

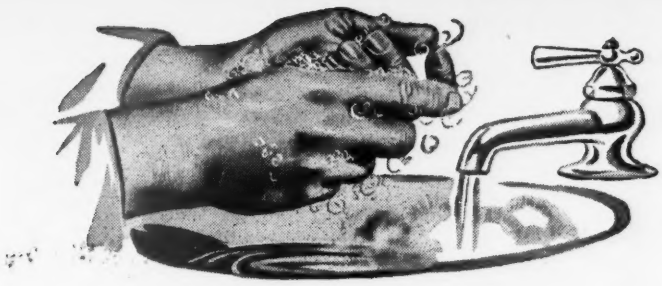
The nutritional contribution made by 1 oz. of cereal, 4 oz. of milk, and 1 teaspoonful of sugar, is shown by the appended table of composite averages.

Calories	**201**
Protein	**7 Gm.**
Carbohydrate	**32 Gm.**
Fat	**5 Gm.**
Thiamine	**0.19 mg.**
Riboflavin	**0.27 mg.**
Niacin	**1.82 mg.**
Calcium	**158 mg.**
Iron	**1.73 mg.**

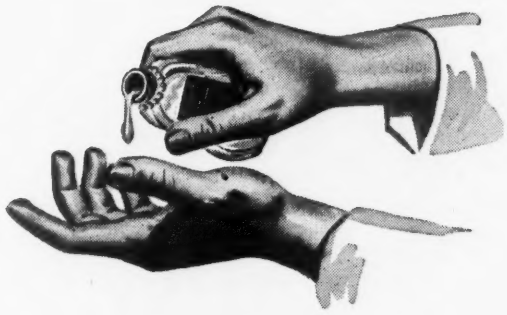
The presence of this seal indicates that all nutritional statements in this advertisement have been found acceptable by the Council on Foods and Nutrition of the American Medical Association.

CEREAL INSTITUTE, INC.
135 SOUTH LA SALLE STREET · CHICAGO 3

HOW MANY TIMES DID YOU WASH YOUR HANDS TODAY?



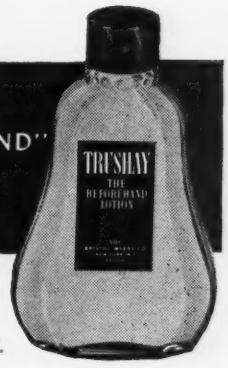
To *prevent* rough, red hands caused by frequent washing



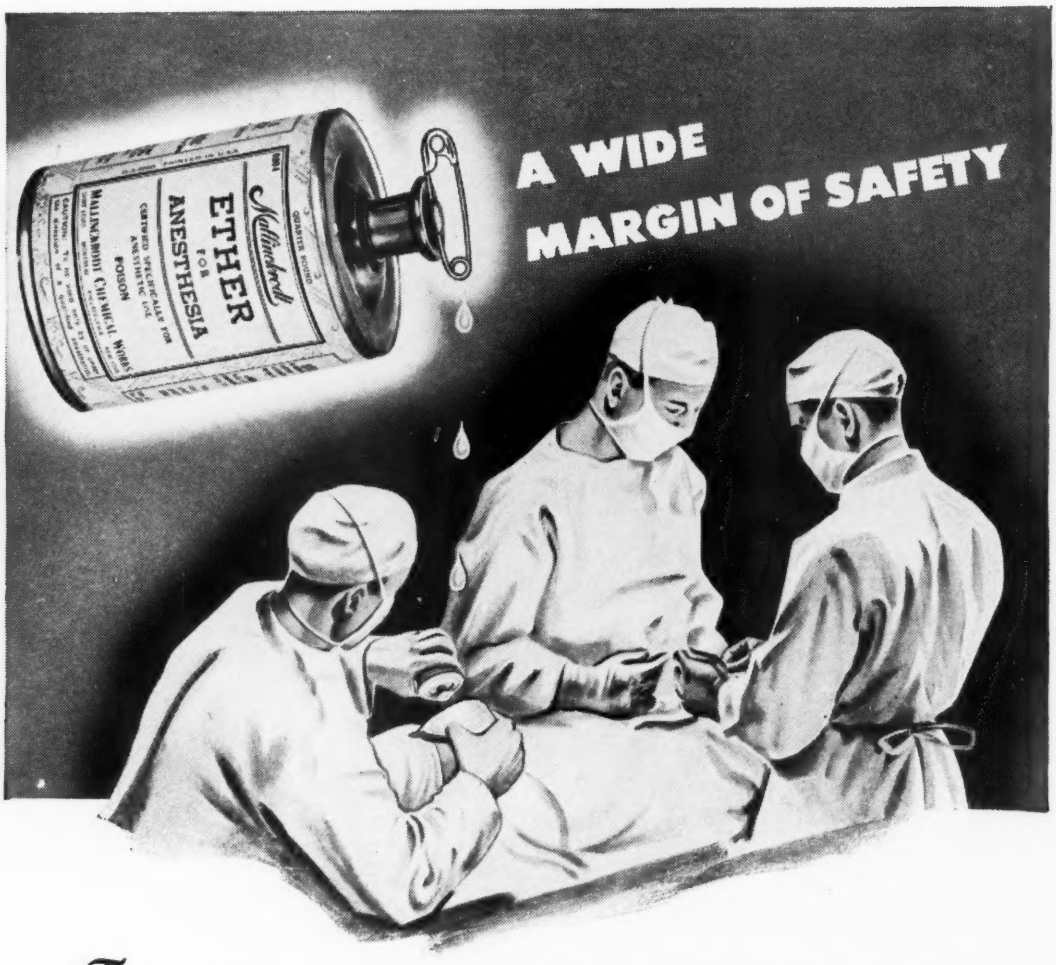
...a few drops of TRUSHAY,
applied *before* washing, gives two-fold protection:

1. TRUSHAY forms a film over the skin surface to help guard against the harsh effects of cleansing and antiseptic agents... helps keep hands smooth and soft.
2. TRUSHAY protects hands by helping to keep skin healthy and unbroken!

Trushay THE "BEFOREHAND" LOTION



A Product of BRISTOL-MYERS COMPANY, 19NFW. 50th St., New York 20, N. Y.



Two of America's leading anesthesiologists recently stated: "Drop ether still remains one of our safest anesthetics."[1]

Safety of the anesthetic agent is of particular importance for the patient in shock. In such cases, "the safest agent, for experienced and inexperienced anesthetists alike, is ether. Its value has been proved in nearly 100 years of continuous use during which many million operations must have been performed. It is the agent with which we have the most experience, which has the widest margin of safety, which has been most carefully investigated both in the laboratory and under clinical conditions."[2]

For extensive procedures in which regional anesthesia is not applicable, ether and oxygen administered through a gas machine is the anesthetic of choice. The method used should be intratracheal, as it will enable the anesthetist to keep the operative field clear for the surgeon, and eliminates all difficulty in maintaining a free airway.[3]

1 Editorial: Anesthetics Old and New, Anesthesia and Analgesia, 23:44, Jan.-Feb. '44
2 R Blair Gould: Anaesthesia for the Patient in Shock, Anesthesiology 5:129, March, '44.
3. Major C F McCuskey: Anesthesia At The Front, The Military Surgeon, April, '44

Unsurpassed { **PURITY** / **STABILITY** / **POTENCY** } *Mallinckrodt Ether for Anesthesia*

MALLINCKRODT CHEMICAL WORKS

78 Years of Service to Chemical Users

Mallinckrodt St., St. Louis 7, Mo. • 74 Gold St., New York 8, N. Y.
CHICAGO • PHILADELPHIA • LOS ANGELES • MONTREAL

FOR VICTORY BUY UNITED STATES WAR BONDS STAMPS

THE *Multi-Purpose* CONTAINER FOR SOLUTIONS, BLOOD AND PLASMA

For collection, storage, refrigeration and administration

Economical . . . both container and vacuum seal are reusable

No transportation problems . . . insures a constant, adequate supply

Will accommodate new reusable inside vent tube which filters as it dispenses

A container especially designed for use with the International B-P centrifuge

Lowers cost of maintaining and operating all 3 essential services

Send for Technical Manual

describing in detail the operation and care of Fenwal equipment • formulae • suggested technics for preparation, processing, storing and administration.

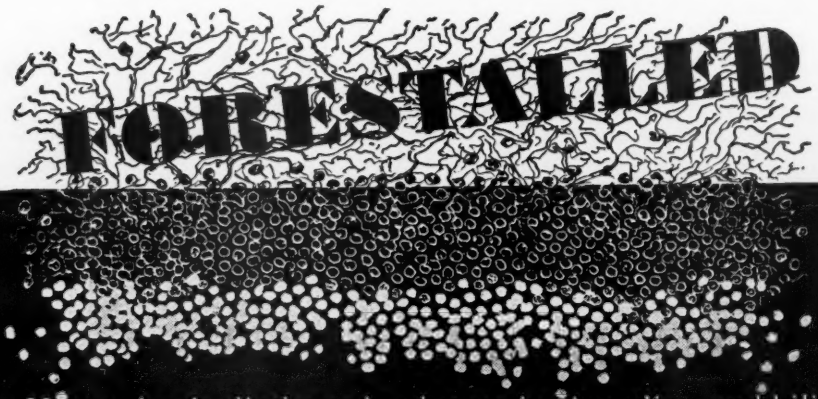
MACALASTER BICKNELL COMPANY

243 Broadway Cambridge, Massachusetts

Fenwal

THE SOLUTION DESIRED AT THE INSTANT REQUIRED

hemorrhagic diatheses



Hemorrhagic diatheses in obstructive jaundice, and biliary fistula, and in the newborn are now known to be dependent upon hypoprothrombinemia. This can be rapidly and effectively forestalled by the administration of

AQUINONE

INTRAMUSCULARLY

AQUAKAY

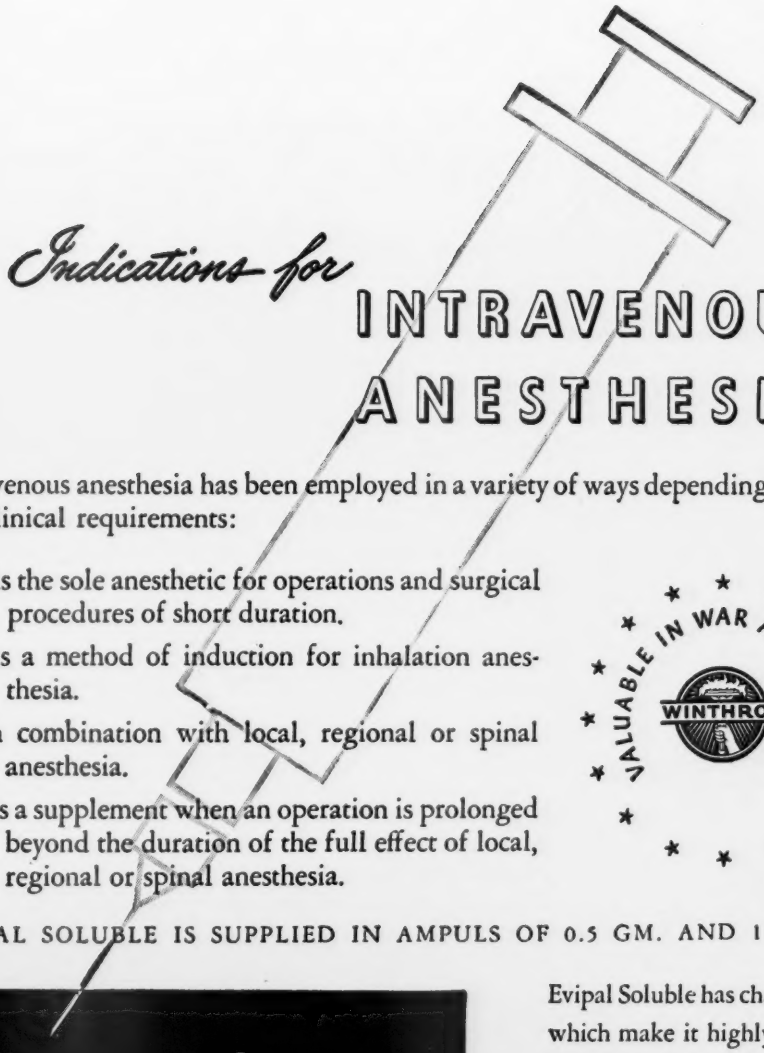
TABLETS ORALLY

vitamin K active preparations of menadione in aqueous solution. Because of the addition of a local anesthetic AQUINONE is free from the usual post-injection discomfort.

Being water-soluble, parenteral AQUINONE is more rapidly and more thoroughly utilized and oral AQUAKAY is more readily absorbed in the intestinal tract without the adjuvant use of bile salts. AQUINONE and AQUAKAY represent the most potent form of vitamin K activity.

Bischoff

ERNST BISCHOFF COMPANY, INC. • IVORYTON, CONNECTICUT



Indications for

INTRAVENOUS ANESTHESIA

Intravenous anesthesia has been employed in a variety of ways depending upon the clinical requirements:

1. As the sole anesthetic for operations and surgical procedures of short duration.
2. As a method of induction for inhalation anesthesia.
3. In combination with local, regional or spinal anesthesia.
4. As a supplement when an operation is prolonged beyond the duration of the full effect of local, regional or spinal anesthesia.

VALUABLE IN WAR AND IN PEACE

WINTHROP

EVIPAL SOLUBLE IS SUPPLIED IN AMPULS OF 0.5 GM. AND 1 GM.

EVIPAL SOLUBLE

"Evipal" Reg. U. S. Pat. Off. & Canada

Brand of HEXOBARBITAL SOLUBLE

(Sodium salt of N-methylcyclohexenylmethyl barbituric acid)

ACCEPTED AMERICAN MEDICAL ASSN. Council on Pharmacy and Chemistry

Evipal Soluble has characteristics which make it highly useful for inducing these various types of anesthesia of short duration. Proper dosage gives deep relaxation of voluntary muscles, yet quick awakening and recovery, generally after twenty or thirty minutes.

WINTHROP CHEMICAL COMPANY, INC.

PHARMACEUTICALS OF MERIT FOR THE PHYSICIAN

New York 13, N. Y • Windsor, Ont.

NOW AVAILABLE THROUGH
PRESCRIPTION PHARMACIES

SPECIFY

Penicillin, Abbott

PENICILLIN, ABBOTT
Supplied in rubber-stoppered, aluminum-sealed vials each containing 100,000 Oxford units

COMBINATION PACKAGE
Vial of 100,000 Oxford units of Penicillin; vial of 20-cc. Isotonic Solution Sodium Chloride, U.S.P.

ABBOTT LABORATORIES, NORTH CHICAGO • ILLINOIS

A Leader in Penicillin Research and Production

THE ADVANTAGES OF LIPIODOL DIAGNOSIS

In Bronchopulmonary Affections

Two impressive facts lend new importance to accurate and early diagnosis of chest involvements: The incidence of chronic bronchopulmonary affections, especially bronchiectasis, is considerably higher than even suspected a few years ago. In many instances the classical signs on which diagnosis can be based, do not appear in bronchiectasis until the advanced stages have been reached, usually too late for effective treatment.

Ordinary chest roentgenography is seldom admittedly adequate for establishing a positive diagnosis of bronchiectasis. With the aid of Lipiodol instilled into the bronchial tree accurate diagnosis is facilitated, even in the early stages of the affection. Since bronchiectasis is largely secondary to infections occurring in childhood, early Lipiodol roentgenography proves an invaluable aid in establishing its presence and toward arresting its progress by appropriate measures.

Lipiodol, the pioneer roentgenographic contrast medium, contains 40% iodine in firm chemical union with poppyseed oil. Its instillation is easily made, even in children. Untoward reactions, systemic or local, are rarely encountered.

REFERENCES: *A Plea For The Prevention of Bronchiectasis*—Karl Kornblum, Am. J. Roentgenol. 51:292 (March) 1944. *The Diagnosis of Bronchiectasis in Young Adults*—Capt. W. A. Evans, Jr., and Capt. L. J. Galinsky, M. C., A. U. S., Am. J. Roentgenol. 51:537 (May) 1944. *The Diagnosis of Bronchiectasis: Clinical and Roentgenological Observations*—Maj. M. H. Joress, and S. A. Robins, Dis. of Chest 10:489 (Nov.-Dec.) 1944.

The supraglottic technic of instillation is simple. After the pharynx and glottis are anesthetized, the tongue is pulled forward and the previously warmed Lipiodol is dropped onto the back of the tongue, the patient breathing deeply and regularly. Thus the desired volume is inspired. Positioning of the patient places the Lipiodol in the area to be explored.

E. FOUGERA & CO., INC.
Distributors
75 Varick Street **New York 13, N. Y.**

Lipiodol (LAFAY)

Lipiodol, made in the U. S. A., is available in a variety of ampule sizes and in 20 cc. rubber-stoppered vials.

ACCEPTED AMERICAN MEDICAL ASSN.

"Oh, she's OLD! Almost thirty!"

At twenty, thirty seems ancient.

At thirty, forty is distant middle age.

At forty, well, it'll be a long time before you're fifty.

The point is that ten years *ahead* always seems like a long time. Yet, actually it passes "before you know it" . . . and you find yourself face to face with problems, opportunities, needs, that once seemed very far in the future.

This is a good thing to remember today, when you buy War Bonds to speed the winning of the war.

In ten years—*only* ten years—those bonds will bring you back $4 for every $3 you put into them today.

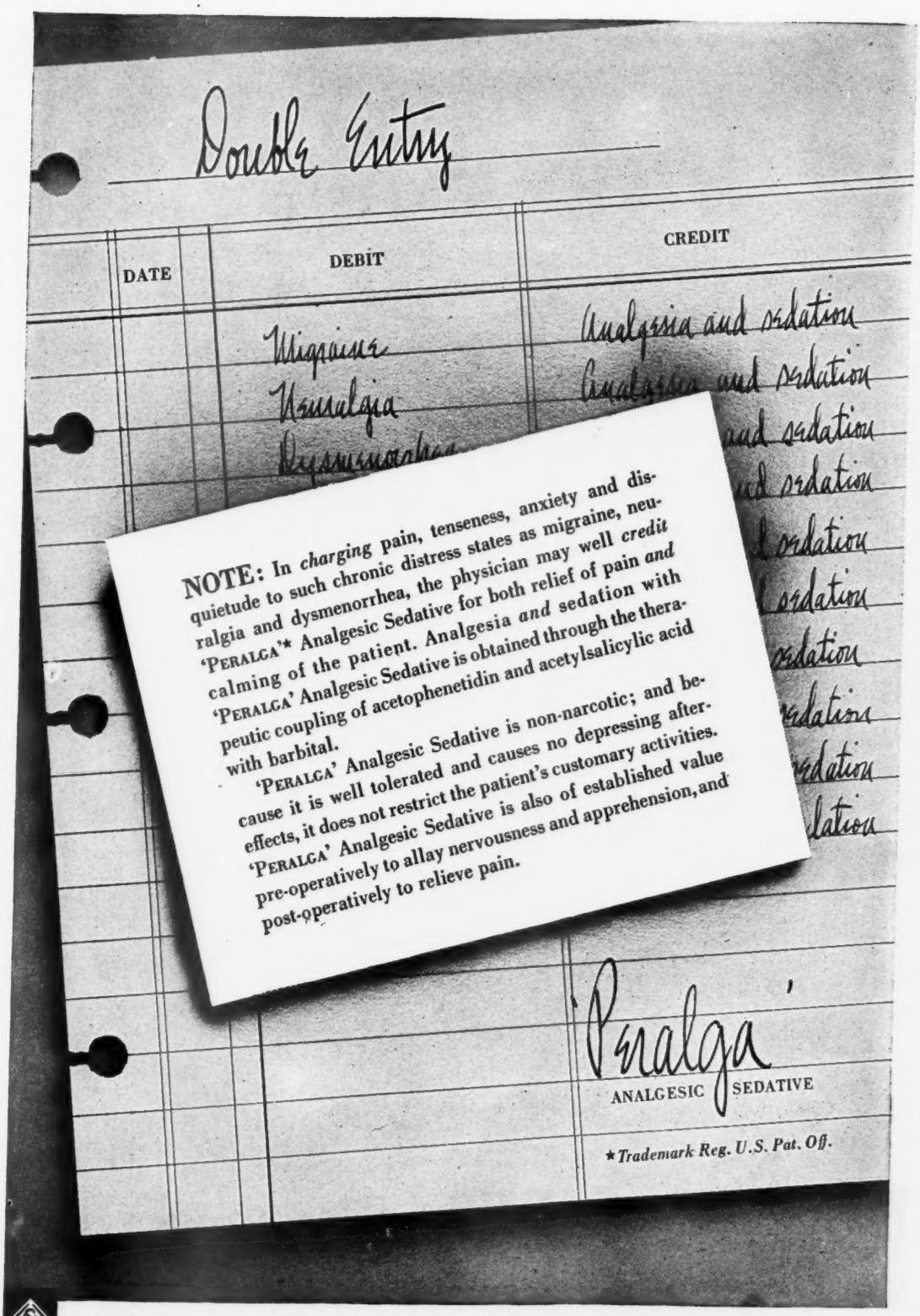
Think of what that money may mean to you in 1955. An education for your children . . . a home . . . maybe even retirement to the place and the life of your heart's desire.

All this your War Bonds can mean to you . . . if you buy all you can today and hold them to maturity.

It won't be long till 1955. Not half as long as you think.

THE AMERICAN JOURNAL OF SURGERY, INC.

This is an official U.S. Treasury advertisement—prepared under auspices of Treasury Department and War Advertising Council


Double Entry
DATE
DEBIT
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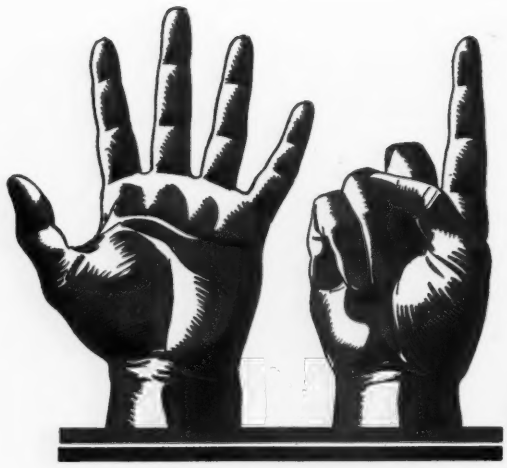
Migraine
Neuralgia
Analgesia and sedation
NOTE: In charging pain, tenseness, anxiety and disquietude to such chronic distress states as migraine, neuralgia and dysmenorrhea, the physician may well credit 'PERALGA'* Analgesic Sedative for both relief of pain and calming of the patient. Analgesia and sedation with 'PERALGA' Analgesic Sedative is obtained through the therapeutic coupling of acetophenetidin and acetylsalicylic acid with barbital.
'PERALGA' Analgesic Sedative is non-narcotic; and because it is well tolerated and causes no depressing after-effects, it does not restrict the patient's customary activities.
'PERALGA' Analgesic Sedative is also of established value pre-operatively to allay nervousness and apprehension, and post-operatively to relieve pain.
Peralga
ANALGESIC SEDATIVE
★Trademark Reg. U.S. Pat. Off.

SCHERING & GLATZ, INC.
a subsidiary of WILLIAM R. WARNER & CO., INC., 113 WEST 18TH STREET, NEW YORK 11, N.Y.



6 VITAL REASONS

FOR PRESCRIBING ORTHO-GYNOL VAGINAL JELLY

No other contraceptive can make *all* these claims . . . substantiated by 34 clinical projects, involving 13,000 patients . . . with reprints of published articles in authoritative medical journals available on request.

1. **ORTHO-GYNOL** Vaginal Jelly is the most widely *prescribed* contraceptive.
2. **ORTHO-GYNOL** Vaginal Jelly is spermicidal on contact—effective *without any delay* after application.
3. **ORTHO-GYNOL** Vaginal Jelly is non-irritating to the vaginal mucosa.
4. **ORTHO-GYNOL** Vaginal Jelly has uniform stability over long periods.
5. **ORTHO-GYNOL** Vaginal Jelly is readily available throughout the United States.
6. **ORTHO-GYNOL** Vaginal Jelly has received A. M. A. Council acceptance.

ORTHO PRODUCTS, INC. • LINDEN, NEW JERSEY

Ortho-Gynol
VAGINAL JELLY

Active ingredients: ricinoleic acid, 0.7%, boric acid, 3.0%, oxyquinoline sulfate 0.025%.

Copyright, 1945, Ortho Products, Inc., Linden, New Jersey

The American Journal of Surgery

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Prolonged SPINAL ANESTHESIA

Twelve years' experience with combined abdominoperineal resections for carcinoma of the rectum[1] showed that NUPERCAINE* 1:1500 — employed almost without exception — helped to provide ideal operating conditions.

As a spinal anesthetic, NUPERCAINE usually gave complete anesthesia for the duration of the one stage combined resection.

NUPERCAINE

an anesthetic with a wide field of usefulness

a Ciba Product

[1]Coller, F. A. and Ransom, H. K.: Carcinoma of the Rectum. Conclusions Based on 12 Years' Experience with Combined Abdominoperineal Resection. Surg., Gynec. & Obst., 78:304,1944.

*Trade Mark Reg. U.S. Pat. Off. Word "Nupercaine" identifies the product as alpha-butyloxy-cinchoninic acid—gamma-diethyl-ethylenediamide-hydrochloride.

CIBA PHARMACEUTICAL PRODUCTS, INC.
SUMMIT, NEW JERSEY
IN CANADA, CIBA COMPANY LIMITED, MONTREAL